CHAPTER 3
AFFECTED ENVIRONMENT

This chapter describes the affected environment, which is the portion of the existing environment likely under the influence of the Rasmussen Valley Mine Project (Proposed Action). The information summarized in this chapter was obtained from field and laboratory studies, published sources, unpublished materials, and communications with relevant governmental personnel as well as individuals with knowledge of the area.

The affected environment varies for each resource. Both the nature of the resource and components of the alternatives define this variation. For some resources, such as geology, soils, and vegetation, the affected area is the physical location and immediate vicinity of the areas that the project would disturb. For other resources, such as water resources, air quality, and social and economic values, the affected environment is larger (e.g., watershed, airshed, and local communities).

The Proposed Action was defined in **Chapter 1** and consists of all areas of proposed surface disturbance including the mine pits, temporary or permanent overburden and overfill piles, GM growth medium (GM) stockpiles, temporary stockpiles, access roads, new haul roads from the mine pits to the existing Wooley Valley Tipple Haul Road, and ancillary mine facilities. The mine footprint is the area within the Proposed Action affected by the mine pits and mine access roads, not including the West Side Haul Road, the Rasmussen Valley Haul Road, storage piles, stockpiles, or ancillary facilities. The Study Area shown on **Figure 1.2-2** (and many of the figures in **Chapter 3**) encompasses the Proposed Action and anticipated elements of the alternatives for which baseline studies were conducted. The Study Area is larger than the Proposed Action. In addition, individual resource sections in this document may discuss an analysis area that is larger than the Study Area. The analysis area defined for a given resource consists of areas of potential direct disturbance in the Study Area plus adjacent areas of indirect effects.

3.1 GEOLOGY, MINERALS, AND PALEONTOLOGY

3.1.1 Geologic Setting

The Study Area is located in the Rocky Mountain Physiographic Province, a region characterized by subparallel folded mountain ranges separated by thinly filled valleys (Mabey and Oriel 1970; Fenneman 1917). **Figure 3.1-1** illustrates the geology of the Study Area and adjacent areas. Geologic units present in the Study Area range from Pennsylvanian (deposited 299 to 318 million years ago) to recent in age. Most geologic units in the Study Area are marine sedimentary deposits. The Permian (251 to 299 million years old) Phosphoria Formation, which contains the phosphatic ore, would be mined under the Proposed Action. Lithologic descriptions, thickness ranges, and hydrogeologic characteristics of major geologic units within the Study Area are included in a general stratigraphic column (**Figure 3.1-2**). Regional geology and stratigraphy are presented in detail in the Rasmussen Valley Mine Project Geology Baseline Study Report (Brown and Caldwell [BC] 2013b).

The Phosphoria Formation is divided into three stratigraphic units including the Cherty Shale, Rex Chert, and Meade Peak Phosphatic Shale Members. The Meade Peak Phosphatic Shale Member (Meade Peak) is the host of phosphate ore in the Southeast Idaho Phosphate District. It is overlain in ascending order by the Rex Chert and Cherty Shale Members.

The Meade Peak Member of the Phosphoria Formation was deposited in an interior marine basin that extended across parts of Idaho, Utah, Wyoming, and southwestern Montana (Perkins and Piper 2004). The basin had a maximum depth of 1,000 to 1,600 feet and was an area of moderate to intense water upwelling, which brought cold, nutrient-rich water to the surface, causing increased algal and plankton productivity. The resulting steady rain of organic debris on the former seafloor is the source of the high-grade phosphorite deposits (Hein 2004, Piper and Link 2002, Moyle and Piper 2004).

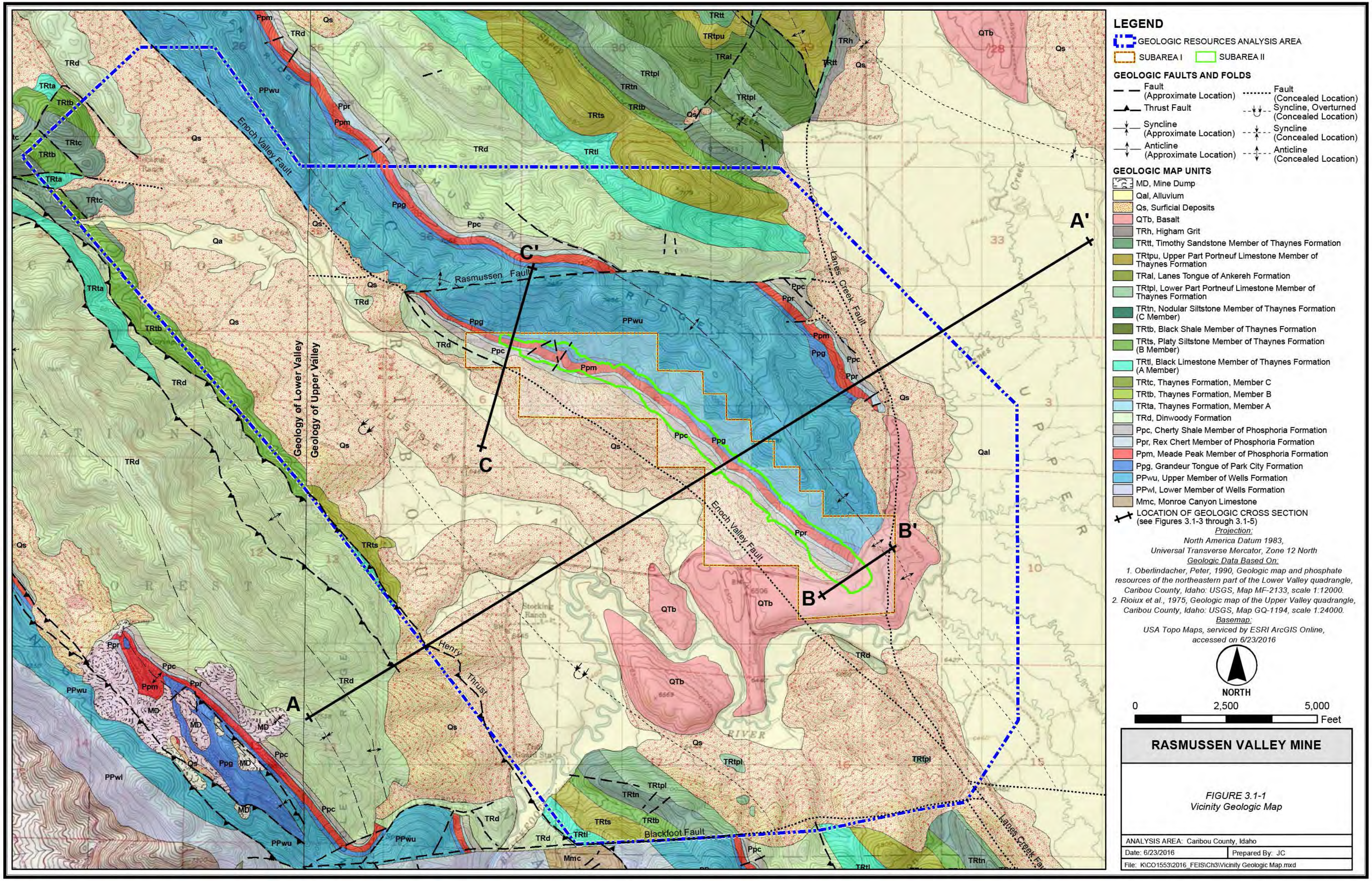
The Phosphoria Formation forms the Western Phosphate Field and comprises one of the world's largest known reserves of phosphate. Phosphate reserves in the Western Phosphate Field are estimated at 1.6 billion metric tons and represent 3 percent of world reserves and 30 percent of U.S. reserves (U.S. Geological Survey [USGS] 2002).

Phosphate is a leasable mineral and one of a group of minerals named in the Mineral Leasing Act of 1920, as amended. Other leasable minerals include oil, gas, geothermal, uranium, coal, and non-energy common minerals (e.g., sodium, potassium, and sulfur). Leasable minerals differ from locatable minerals, for which a claim is staked after an ore body is found. Locatable minerals include metallic minerals (e.g., gold, silver, lead, copper, zinc, nickel), non-metallic minerals (e.g., fluorspar, mica, certain limestones and gypsum, tantalum, heavy minerals in placer form, and gemstones), and certain uncommon variety minerals. Locatable minerals have not been identified at concentrations that would justify extraction within the Study Area. Salable minerals, such as sand and gravel, are commonly located in alluvial drainages but are not currently being extracted from within the Study Area and are not protected by leases or mining claims.

3.1.2 Seismicity and Geotechnical Setting

3.1.2.1 Structural Setting

The Study Area is situated on the southwest-dipping limb of the northwest-trending Snowdrift Anticline, the axis of which generally parallels Rasmussen Ridge. A general cross-section of the geological resources analysis area shows the position of the Snowdrift Anticline in relation to the Lanes Creek and Enoch Valley Faults and other locally significant features (**Figure 3.1-3**). **Figure 3.1-4** and **Figure 3.1-5** show cross-sections south and north, respectively, of the general cross-section developed based on data collected from within the Study Area (BC 2013b). Within the Study Area, structural dip generally increases to the north, ranging from an average of 32 degrees to the southwest near the south end of the anticline to nearly vertical to overturned near the north end (BC 2013b). The Snowdrift Anticline and similar northwest-trending features in the region were formed by compressional forces during the late Cretaceous (Petrun 1999). High-angle normal faults in the region (e.g., Lanes Creek and Enoch Valley Faults) were mostly formed during Basin and Range extension starting in the Miocene 17 million years ago (Mabey and Oriel 1970). The Rasmussen and Blackfoot Faults have been interpreted as tear faults associated with thrust faulting, and other minor tear faults have been mapped within the northern portion of the Study Area (STRATA 2013).



LEGEND
GEOLOGIC RESOURCES ANALYSIS AREA
SUBAREA I
SUBAREA II
GEOLOGIC FAULTS AND FOLDS
Fault (Approximate Location)
Thrust Fault
Syncline (Approximate Location)
Anticline (Approximate Location)
Fault (Concealed Location)
Syncline, Overturned (Concealed Location)
Syncline (Concealed Location)
Anticline (Concealed Location)
GEOLOGIC MAP UNITS
MD, Mine Dump
Qal, Alluvium
Qs, Surficial Deposits
QTb, Basalt
TRh, Higham Grit
TRtt, Timothy Sandstone Member of Thaynes Formation
TRtpu, Upper Part Portneuf Limestone Member of Thaynes Formation
TRal, Lanes Tongue of Ankereh Formation
TRtpl, Lower Part Portneuf Limestone Member of Thaynes Formation
TRtn, Nodular Siltstone Member of Thaynes Formation (C Member)
TRtb, Black Shale Member of Thaynes Formation
TRts, Platy Siltstone Member of Thaynes Formation (B Member)
TRtl, Black Limestone Member of Thaynes Formation (A Member)
TRtc, Thaynes Formation, Member C
TRtb, Thaynes Formation, Member B
TRta, Thaynes Formation, Member A
TRd, Dinwoody Formation
Ppc, Cherty Shale Member of Phosphoria Formation
Ppr, Rex Chert Member of Phosphoria Formation
Ppm, Meade Peak Member of Phosphoria Formation
Ppg, Grandeur Tongue of Park City Formation
PPwu, Upper Member of Wells Formation
PPwl, Lower Member of Wells Formation
Mmc, Monroe Canyon Limestone
LOCATION OF GEOLOGIC CROSS SECTION (see Figures 3.1-3 through 3.1-5)
Projection:
North America Datum 1983,
Universal Transverse Mercator, Zone 12 North
Geologic Data Based On:
1. Oberlindacher, Peter, 1990, Geologic map and phosphate resources of the northeastern part of the Lower Valley quadrangle, Caribou County, Idaho: USGS, Map MF-2133, scale 1:12000.
2. Rioiux et al., 1975, Geologic map of the Upper Valley quadrangle, Caribou County, Idaho: USGS, Map GQ-1194, scale 1:24000.
Basemap:
USA Topo Maps, serviced by ESRI ArcGIS Online, accessed on 6/23/2016
NORTH
0
2,500
5,000
Feet
RASMUSSEN VALLEY MINE
FIGURE 3.1-1
Vicinity Geologic Map
ANALYSIS AREA: Caribou County, Idaho
Date: 6/23/2016
Prepared By: JC
File: K:\CO1553\2016_FEIS\Ch3\Vicinity Geologic Map.mxd
A
A'
B
B'
C
C'
Enoch Valley Fault
Rasmussen Fault
Lanes Creek Fault
Henry Thrust
Blackfoot Fault
Geology of Lower Valley
Geology of Upper Valley

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AGE	UNIT		THICKNESS	LITHOLOGY	DESCRIPTION
QUATERNARY	ALLUVIUM		3-80 ft		SANDS AND CLAYS
QUATERNARY	BASALT		29-57 ft		BASALT
QUATERNARY	ALLUVIUM/COLLUVIUM		0-120 ft		GRAVELS, SANDS, AND LAKEBED CLAYS
TRIASSIC	DINWOODY FORMATION		72 ft		SHALE
PERMIAN	PHOSPHORIA FORMATION	CHERTY SHALE MEMBER	55-232 ft		SILICEOUS SHALE
PERMIAN	PHOSPHORIA FORMATION	REX CHERT MEMBER	29-80 ft		CHERT - THICK TO MASSIVE BEDDED
PERMIAN	PHOSPHORIA FORMATION	MEADE PEAK MEMBER	15-35 ft		UPPER WASTE (HANGING WALL MUD)
PERMIAN	PHOSPHORIA FORMATION	MEADE PEAK MEMBER	15-18 ft		UPPER ORE - LOW/MEDIUM TO HIGH GRADE (INTERBEDDED PHOSPHORITE, MUDSTONE, SILTSTONE, LIMESTONE, AND SHALE)
PERMIAN	PHOSPHORIA FORMATION	MEADE PEAK MEMBER	80-110 ft		CENTER WASTE SHALE - MUDSTONE AND SHALE
PERMIAN	PHOSPHORIA FORMATION	MEADE PEAK MEMBER	28-38 ft		LOWER ORE - LOW TO HIGH GRADE (INTERBEDDED PHOSPHORITE, MUDSTONE, SILTSTONE, LIMESTONE, AND SHALE)
PERMIAN	PHOSPHORIA FORMATION	MEADE PEAK MEMBER	5-10 ft		FOOTWALL MUD
PERMIAN	GRANDEUR TONGUE MEMBER		40-80 ft		DOLOMITE AND SANDSTONE
PENNSYLVANIAN TO PERMIAN	WELLS FORMATION		1,350-1,450 ft		LIMESTONE, DOLOMITE, AND SANDSTONE

Source: *2012 Geologic Baseline Report, Brown and Caldwell*

RASMUSSEN VALLEY MINE

FIGURE 3.1-2
Generalized Column and Stratigraphic Section for Project Area

ANALYSIS AREA: Caribou County, Idaho
Date: 8/28/2015 | Prepared By: JC
File: K:\CO1553\Image\2016_FEIS\EIS_StratiColumns.ai

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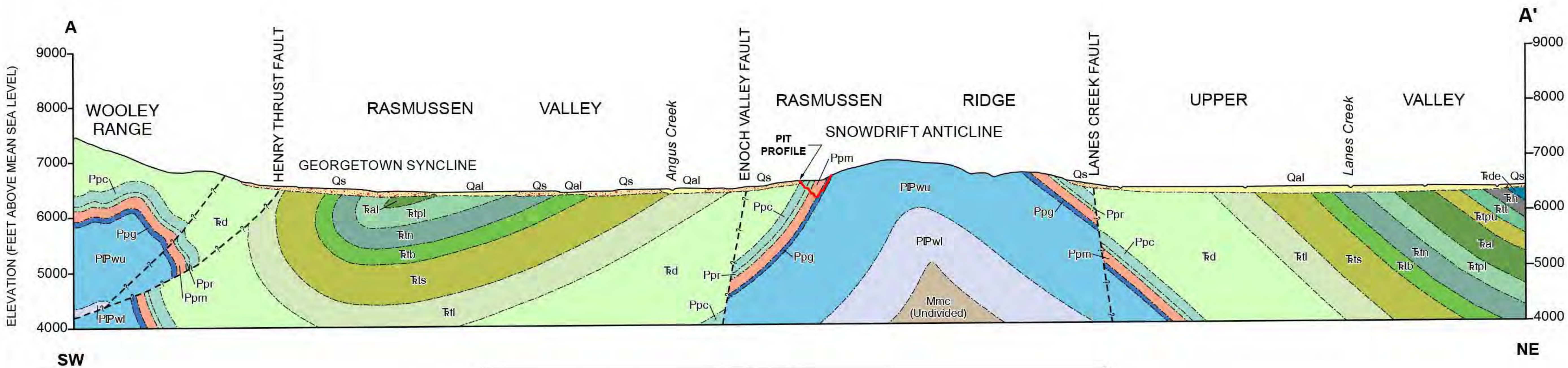


GEOLOGY

- Qal ALLUVIUM
- Qs SURFICIAL DEPOSITS
- Ŧde DEADMAN LIMESTONE
- Ŧh HIGHAM GRIT
- Ŧal LANES TONGUE OF ANKAREH FORMATION

THAYNES FORMATION

- Ŧt TIMOTHY SANDSTONE MEMBER
- Ŧpu UPPER PART OF PORTNEUF LIMESTONE MEMBER
- Ŧpl LOWER PART OF PORTNEUF LIMESTONE MEMBER
- Ŧn NODULAR SILTSTONE MEMBER
- Ŧts PLATY SILTSTONE MEMBER
- Ŧtl BLACK LIMESTONE MEMBER
- Ŧb MEMBER B
- Ŧd DINWOODY FORMATION

PHOSPHORIA FORMATION (PERMIAN)

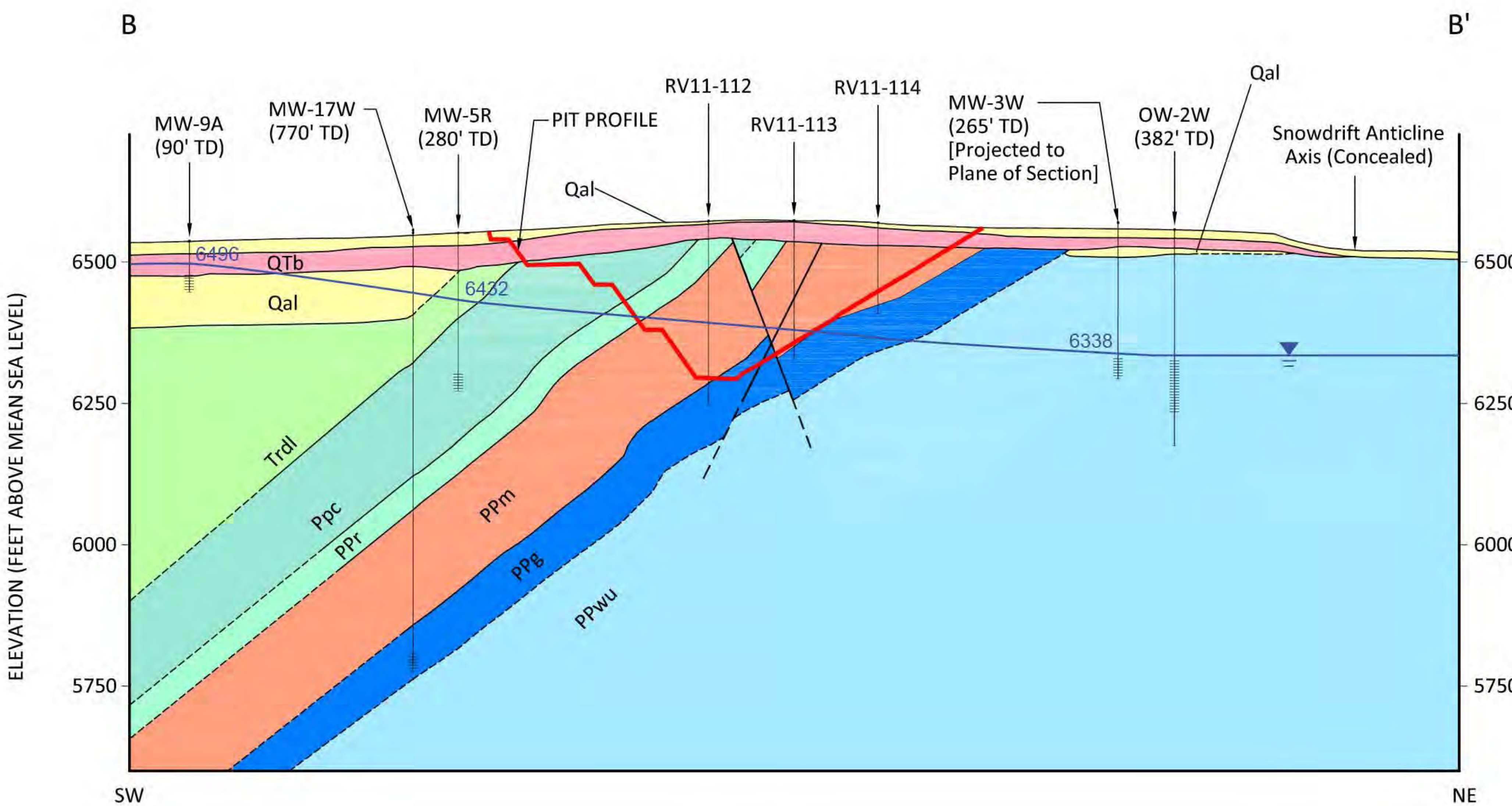
- Ppc CHERTY SHALE MEMBER
- Ppr REX CHERT
- Ppm MEADE PEAK PHOSPHATIC SHALE MEMBER
- Ppg GRANDEUR TONGUE OF PARK CITY FORMATION
- PIPwu WELLS FORMATION (UPPER)
- PIPwl WELLS FORMATION (LOWER)
- Mmc MONROE CANYON LIMESTONE (UPPER MISSISSIPPIAN)
- - - -? FAULT
- PIT PROFILE

Source: Upper Valley Quadrangle (Rioux et al, 1975).

RASMUSSEN VALLEY MINE

FIGURE 3.1-3
Geologic Cross Section A-A'

ANALYSIS AREA: Caribou County, Idaho
Date: 6/23/2016 | Prepared By: JC
File: K:\CO1553\2016_FEIS\Chapter3\GeologicXS_AA.mxd



GEOLOGY

Qal	SURFICIAL DEPOSITS (QUATERNARY)
QTb	BASALT (PLIOCENE/PLEISTOCENE)
Trdu	UPPER DINWOODY FORMATION (LOWER TRIASSIC)
Trdl	LOWER DINWOODY FORMATION (LOWER TRIASSIC)
	WATER TABLE

PHOSPHORIA FORMATION (PERMIAN)

Ppc	CHERTY SHALE MEMBER
PPr	REX CHERT MEMBER
PPm	MEADE PEAK MEMBER
PPg	GRANDEUR TONGUE (PERMIAN)
PPwu	WELLS FORMATION (PERMIAN-PENNSYLVANIAN)

Sources:
Geology based on Agrium exploration borings and well logs, Rioux et al. (1975), and professional judgement.

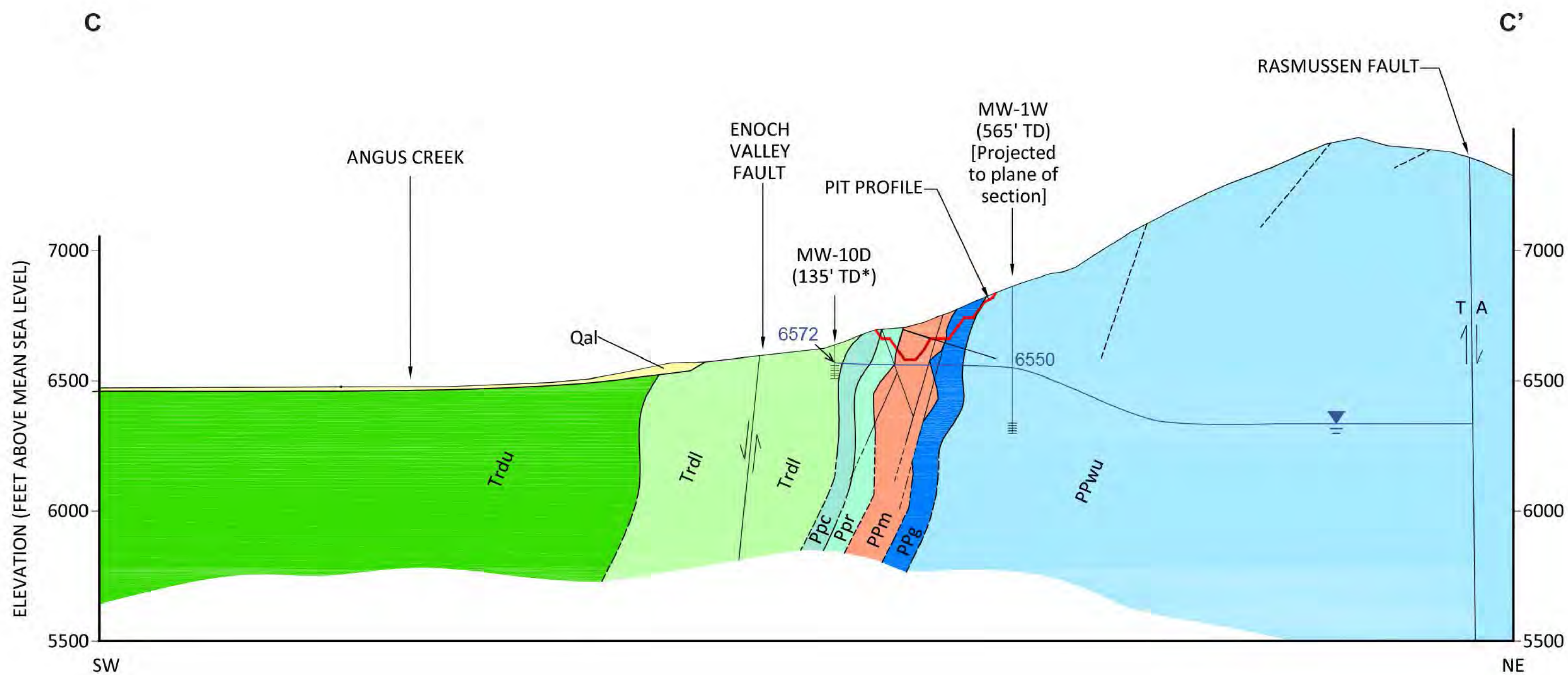
TD = TOTAL DEPTH

Source: Revised from Figure 11 in 2012 Geology Baseline Report, Brown and Caldwell.

RASMUSSEN VALLEY MINE

FIGURE 3.1-4
Geologic Cross Section B-B'

ANALYSIS AREA: Caribou County, Idaho
Date: 8/28/2015 | Prepared By: JC
File: K:\CO1553\Image\2016_FEIS\EIS_GeoCrossSection BB.ai



GEOLOGY

Qal	SURFICIAL DEPOSITS (QUATERNARY)
QTb	BASALT (PLIOCENE/PLEISTOCENE)
Trdu	UPPER DINWOODY FORMATION (LOWER TRIASSIC)
Trdl	LOWER DINWOODY FORMATION (LOWER TRIASSIC)
	WATER TABLE

PHOSPHORIA FORMATION (PERMIAN)

Ppc	CHERTY SHALE MEMBER
PPr	REX CHERT MEMBER
PPm	MEADE PEAK MEMBER
PPg	GRANDEUR TONGUE (PERMIAN)
PPwu	WELLS FORMATION (PERMIAN-PENNSYLVANIAN)

*Well abandoned from 135' to 995'. VWP installed at 330'. Borehole deviation prevented interception of target formation (Ppc/PPr)

Sources:
Geology based on Agrium exploration borings and well logs, Rioux et al. (1975), and professional judgement.

TD = TOTAL DEPTH

VWP = VIBRATING WIRE PIEZOMETER

Source: Revised from Figure 13 in 2012 Geology Baseline Report, Brown and Caldwell.

RASMUSSEN VALLEY MINE

FIGURE 3.1-5
Geologic Cross Section C-C'

ANALYSIS AREA: Caribou County, Idaho
Date: 8/28/2015 | Prepared By: JC
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3.1.2.2 Seismicity and Geotechnical Stability

The Study Area lies within a Zone III seismic region extending from northern Arizona, through the Wasatch Front in Utah, to the Yellowstone and Hebgen Lake regions in Wyoming and Montana. About 20 earthquakes capable of damaging structures (magnitudes greater than 5.0 on the Richter scale) occurred within this seismic region from 1880 through 1994. The Idaho Geological Survey has mapped the southeastern part of Idaho, including the Study Area, as having the highest of three seismic shaking rankings (Bureau of Land Management [BLM] and U.S. Forest Service [USFS] 2007).

Between 1972 and 2011, 62 earthquakes with magnitudes greater than 4.0 occurred within 50 miles of the Study Area. These events are all characterized by shallow crustal movement (i.e., epicenter depth less than 10 miles). The largest event was a magnitude 5.8 earthquake that occurred on February 3, 1994 near Afton, Wyoming, 19 miles east of the Study Area. This event, known as the Draney Peak Earthquake, was part of a swarm of earthquakes that occurred over a 10-day period. Although shaking was felt as far away as Grand Junction, Colorado, no damage was reported in Bonneville, Teton, or Caribou Counties (Post Register 1994). Another significant event was a magnitude 5.3 earthquake that occurred April 21, 2001 near Henry Peak, 6 miles north of the Study Area (USGS 2012). Although several earthquakes have occurred in recent years, and slide debris is prevalent within the Study Area (STRATA 2013), no instances of seismically induced slope failure are known to have occurred within the Study Area.

Ground shaking within the Study Area is likely a function of extensional fault activity more than 8 miles away from the Study Area (USGS 2014a). Parameters for the active, major fault systems closest to the Study Area are presented in **Table 3.1-1**. The individual fault with the greatest likelihood of contributing to site seismicity is the Grand Valley Fault, located 20 miles east of the Study Area (USGS 2014a).

Table 3.1-1 Active Fault Parameters in the Vicinity of the Study Area

Fault	Distance from Study Area	Characteristic Earthquake Magnitude	Recurrence Interval for Characteristic Magnitude (years)	Recurrence Interval for M= 6.5 Event (years)
Eastern Bear Lake Fault	42 miles south	7.3	2,580	630
Grand Valley Fault	20 miles east	7.1	1,370	480
Greys River Fault	34 miles east	7.1	2,700	940

Source: STRATA 2013

Earthquake-generated ground shaking is typically the greatest cause of damage during an earthquake. Earthquake statistics can be used to estimate the level of ground motion likely to occur within a certain number of years. These estimates are most commonly made in terms of peak ground acceleration (PGA). The predicted PGA value for the Study Area for an earthquake with a 475-year mean return time (10 percent probability of occurring in 50 years) is approximately 19%g, where g is equal to acceleration resulting from gravity at the Earth's surface (USGS 2014a). Seismic analysis conducted by STRATA (2013) used a PGA of 42%g for an earthquake with a return interval of 2,475 years when assessing potential instability of site features resulting from earthquakes. This provides a more conservative estimate (more acceleration and more potential for damage). Evidence of landslides has been observed within the Study Area, particularly in SW¼ Section 5, T7S R44E. Based on inclinometer data, these landslide deposits are currently exhibiting movement. Colluvial deposits in much of the Study Area also display evidence indicating that soil movement has occurred in the recent past (STRATA 2013).

3.1.3 Mineralogy and Geochemistry

3.1.3.1 Mineralogy and Elemental Distribution

The mineral assemblage of the Meade Peak at Rasmussen Valley is dominated by quartz and feldspar with subordinate amounts of carbonate fluorapatite (CFA), dolomite, calcite, clay, and oxide minerals (GeoSystems 2014). CFA is the primary phosphate mineral in the geologic materials that will comprise both ore and overburden. Pyrite (iron sulfide) and sphalerite (zinc sulfide) occur as fine-grained trace minerals disseminated in the rock matrix or replacing cementing agent between mineral grains. Selenium and nickel are strongly associated with pyrite. Cadmium is associated with sphalerite (Grauch et al. 2004).

Pyrite is the principal host of selenium in Meade Peak rocks. A small fraction of selenium is also present in elemental form. Selenite (Se^{4+}) is more abundant than reduced forms of selenium in weathered rocks and is associated with oxyhydroxide minerals and organic matter. It is assumed that the selenite is derived from the oxidation of primary sulfide minerals (Perkins and Foster 2004). Oxidation reactions involve the loss of electrons from metallic ions and metalloids. Reduction reactions occur when metallic ions and metalloids gain electrons. Sphalerite and organic matter are the primary hosts of cadmium and zinc in unweathered rocks. Cadmium and zinc tend to be strongly adsorbed to oxyhydroxide minerals where the Meade Peak is weathered (Perkins and Foster 2004).

Organic matter and oxyhydroxide minerals contain the majority of selenium, cadmium, copper, zinc, nickel, and vanadium that are not associated with sulfide minerals. Apatite is the primary host for uranium. Both apatite and organic matter host molybdenum. Chromium and vanadium occur as acid-insoluble phases that are probably silicate and oxide minerals (Perkins and Foster 2004).

3.1.3.2 Environmental Mobility of Selenium

Reduced forms of selenium, such as selenide (Se^{2-}), selenite, and elemental selenium (Se^{0}), have relatively low environmental mobility in water compared to oxidized forms, such as biselenate (Stewart and Howell 2003; Mebane et al. 2015). Mobile forms of selenium can be transported in water and bioaccumulate in plants and organisms (Pickering et al. 1995; Hem 1989; Fessler et al. 2003; Masscheleyn et al. 1990). The pH and oxidation and reduction (redox) conditions of natural surface waters, including those in the region, generally promote higher mobility of selenate than less oxidized forms such as selenite (Mebane et al. 2015; Brookins 1988).

Geochemical controls that reduce or limit the mobility of selenium in water include adsorption to mineral surfaces such as oxyhydroxides of iron, manganese, and aluminum (Hayes et al. 1987; Balistrieri and Chao 1990; Rajan 1979). Clay and carbonate minerals may also provide effective surfaces for selenium adsorption (Bar-Yosef and Meek 1987; Cowan et al. 1990). Redox potential and pH both affect selenium solubility and adsorption reactions. Adsorption of selenium is least efficient under oxidizing conditions at circum-neutral pH (Elrashidi et al. 1987). Selenite is more strongly retained than selenate by sorption to mineral surfaces and by microbial reactions (Stewart and Howell 2003).

Redox reaction rates for selenium can be rapid (Pickering et al. 1995) with the dissolved species selenite and selenate (Se^{6+}) being readily reduced to insoluble elemental selenium (Hem 1989). Likewise, elemental selenium and selenide are easily oxidized to forms that are more mobile in the environment (Pickering et al. 1995). Microbial processes strongly affect the redox state of selenium. Selenate in solution is reduced to elemental selenium and precipitated by anaerobic bacteria in a wide range of sediments (Stolz et al. 2002). Oxidizing bacteria may also mobilize selenium in favorable environments. Bacterially mediated oxidation rates are generally three to four orders of magnitude slower than bacterially mediated reduction (Stolz et al. 2002).

Selenium bioaccumulates in plants and, although it is an essential micronutrient for the maintenance of health in mammals, it is toxic to mammals at relatively modest concentrations in vegetation (Fessler et al. 2003). Organo-selenium compounds are commonly formed in plant tissue and may become present in soil and water by the release from decaying seleniferous vegetation. Microorganisms can methylate selenium, and methyl-selenium compounds can be volatilized to the atmosphere (Flury et al. 1997; Frankenberger and Karlson 1995).

3.1.3.2.1 Regional Selenium Studies

A number of regional studies have evaluated the release mechanisms, transportation pathways, and environmental effects of selenium from phosphate mine overburden. Important conclusions of these studies include the following:

- Two mechanisms control the release of selenium from unsaturated overburden. The primary release occurs from water-soluble selenium that was present in the material (such as overburden) at the time of placement. The secondary release is from the weathering of sulfide minerals (primarily pyrite) and organic material. Weathering reactions are sluggish, and releases by this mechanism are smaller than those from water-soluble selenium (Tetra Tech 2008).
- The oxygen content in the pore spaces of overburden is independent of the type of waste rock facility and age, but appears to be affected by the method used to construct the facility. End dumping from the pit crest, a ramp, or a lift appears to support overburden piles with oxygenated interiors. Plug or butt dumping tends to result in oxygen-depleted conditions (Tetra Tech 2008).
- The content of water-soluble selenium in unsaturated oxygenated and oxygen-depleted overburden piles is similar. This observation suggests that microbiological reduction of selenium in oxygen-depleted overburden piles is limited (Tetra Tech 2008).
- Selenium concentrations in overburden seeps vary seasonally, with the highest concentrations typically occurring during spring runoff, mostly as selenate. Organic selenide concentrations tend to increase as a percentage of total selenium concentration in area streams and rivers during low-flow periods. A change in speciation to reduced selenium may indicate elevated biotic productivity during summer months and could result in enhanced selenium uptake in food webs (Presser et al. 2004).
- Selenium concentrations in wetlands, sediment, and vegetation decrease with increasing distance away from overburden seeps. Controlling mechanisms include adsorption or co-precipitation with iron oxides and organic matter in sediments, and plant uptake (Stillings and Amacher 2004).
- Selenium concentrations in water, stream sediments, aquatic plants, and invertebrates are correlated (Hamilton 2004).
- Selenium is usually present in streams in three forms: selenate, selenite, and organic selenium, in order of usual relative abundance (Mebane et al. 2015).
- Selenium concentrations in vegetation on uncapped phosphate overburden piles, and in wetlands receiving seepage from overburden piles, are approximately 20 times higher than in vegetation at undisturbed sites (Mackowiak et al. 2004).

3.1.3.3 Baseline Geochemical Characterization Study

A geochemical characterization study of the planned overburden and ore from the Proposed Action was completed to assess the potential environmental impacts that could occur from material handling and disposal. The study included an extensive sampling and testing program with an analysis of the mineralogy and elemental content of the rocks that would be produced from the mine. Leaching studies, attenuation testing, and an evaluation of the acid-producing potential of the proposed overburden and ore were also completed to evaluate the mobility of metals and other constituents in seepage from the pit backfill, external overburden piles, and temporary ore stockpiles.

3.1.3.3.1 Study Design and Test Materials

The Proposed Action would produce about 64.88 million tons of overburden, which would be placed in external overburden piles or backfilled into the mined out pit (BC 2013b). The majority of overburden (76.5 percent) would be derived from the Phosphoria Formation. The remaining material (23.5 percent) would include basalt, alluvium, Grandeur Tongue, and Wells Formation. The estimated overburden material balance for the Proposed Action is summarized in **Table 3.1-2**.

Table 3.1-2 Estimated Overburden Material Balance for the Proposed Action

Lithology	Million Tons of Material	Percent Total
Alluvium	2.72	4.2
Basalt	0.51	0.8
Cherty Shale	9.55	14.7
Rex Chert	10.88	16.8
Hanging Wall Mud	4.07	6.3
Center Waste	20.61	31.8
Ore Partings	3.70	5.7
Footwall Mud	0.84	1.3
Grandeur Tongue	10.32	15.9
Wells Formation	1.67	2.6

Source: BC 2013b

The baseline geochemistry study (Whetstone 2015a) evaluated a total of 4,085 samples from 45 boreholes and nine surface trenches for use in the testing program. The samples were geologically logged and reviewed for adequacy based on location, volume of available material, and completeness of the intersected stratigraphy. Based on this review, material representing 2-foot intervals from five boreholes (629 samples) were analyzed for whole-rock elemental content by x-ray fluorescence (XRF), and material from 27 boreholes (2,818 samples) and nine surface trenches (12 samples) were composited to form 158 samples (A-composite samples) that represented a single rock type from each borehole or trench. The A-composite samples were analyzed for elemental content by inductively coupled plasma atomic emission spectroscopy and mass spectrometry (ICP-AES/MS), leaching characteristics by acid-base accounting (ABA), and synthetic precipitation leaching procedure (SPLP) tests. The number of A-composite samples tested for each rock type is summarized in **Table 3.1-3**.

Table 3.1-3 Summary of A-Composite Samples that were Analyzed by ICP-AES/MS, SPLP, and ABA Tests for the Baseline Geochemistry Study

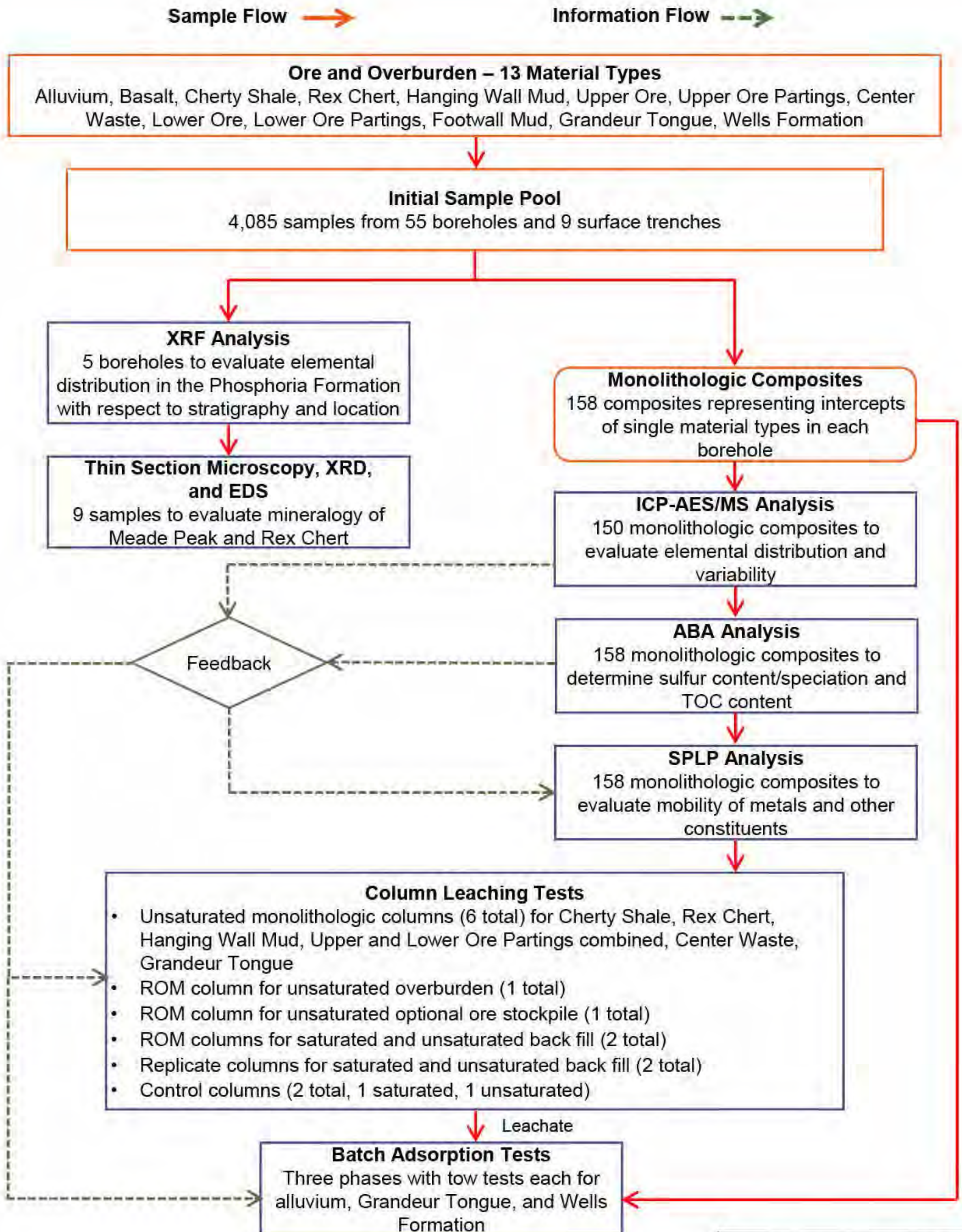
Material Type	Number of Tested A-Composite Samples
Alluvium	17
Basalt	6
Cherty Shale	14
Rex Chert	24
Hanging Wall Mud	13
Upper Ore Partings	6
Upper Ore	6
Center Waste	22
Lower Ore Partings	9
Lower Ore	9
Footwall Mud	8
Grandeur Tongue	18
Wells Formation	6

Upon completion of the ICP-AES/MS, ABA, and SPLP tests, splits of the A-Composite were combined to form B-Composite samples that represented the average composition of each rock type for the entire site. The B-Composite samples were used for column leaching studies to develop loading terms for the groundwater contaminant fate-and-transport model. In addition to the tests previously discussed, the geochemistry study also evaluated the mineralogical content of selected samples using transmitted light thin-section microscopy (thin-section analysis), x-ray diffraction (XRD), energy dispersive x-ray spectroscopy (EDS), and backscatter imaging (BEI) with electron microscopy (Whetstone 2015a).

An overview of the testing program is presented on **Figure 3.1-6**. The following sections summarize the results of the mineralogical studies, the elemental content analyses, and the ABA testing. The SPLP and column leaching tests provide data to evaluate the potential environmental impacts from the proposed mining operation and are discussed in **Chapter 4**.

The results of the mineralogical analyses indicate that overburden and ore from the Study Area are extensively weathered (oxidized). Quartz is the primary component of the Rex Chert and Cherty Shale (89 to 99 percent) with clay minerals, feldspar, glauconite, jarosite, and pyrite making up the remaining percentage of the rock mass. Selenium was observed by BEI as oxide compound associated with organic matter in the Rex Chert.

The primary components of the Meade Peak rocks are quartz (8 to 63 percent) and CFA (trace to 70 percent). Clays, including illite with lesser amounts of smectite, comprised 4 to 26 percent of the tested samples. The carbonate content of the Meade Peak rocks ranged from 0 to 13 percent. Sulfide minerals were generally sparse, with pyrite and a selenium-sulfide compound being the only minerals that were positively identified by XRD or BEI. Selenium was observed as an oxide mineral in both Meade Peak ore and overburden. The pyrite content of the Meade Peak samples ranged from 0 to 6 percent. Manganese, nickel, and zinc were observed in association with oxide minerals and organic matter, but relatively few trace metals were present at high enough concentrations to be identified by BEI. This result is probably a function of weathering, which causes dispersion of the metals throughout the matrix, lowering the concentration to below the detection limit at any given point.



XRD = X-Ray Defraction
XRF = X-Ray Fluorescence
EDS = Energy Dispersive x-ray Spectroscopy
ICP-AES/MS = Inductively Coupled Plasma Atomic Emission Spectroscopy and Mass Spectrometry
ABA = Acid-Based Accounting
SPLP = Synthetic Precipitation Leaching Procedure
ROM = Run of Mine

RASMUSSEN VALLEY MINE

FIGURE 3.1-6
Overview of the Baseline Geochemistry Characterization Study

ANALYSIS AREA: Caribou County, Idaho
Date: 8/28/2015 | Prepared By: JC
File: K:\CO1553\Image\2016_FEIS\EIS_BaselineGeoChemCharStudy.ai

3.1.3.3.2 Elemental Distribution Analysis

The results of the XRF and ICP-AES/MS analyses indicated that trace metals of potential environmental concern are widely distributed throughout the proposed overburden and ore (Whetstone 2015a). ICP-AES/MS data indicate that antimony, arsenic, cadmium, calcium, chromium, copper, iron, magnesium, manganese, molybdenum, nickel, phosphorus, selenium, silver, strontium, thallium, uranium, vanadium, and zinc are present in Rasmussen Valley rocks at concentrations that are above world shale averages (WSAs; **Table 3.1-4**). The trace metal content varies by lithology and location with the Meade Peak Member having the highest average metal content followed by the Cherty Shale and Rex Chert. Evaluation of the XRF data indicates that most metals do not exhibit obvious spatial trends of increasing or decreasing concentration along the strike of the deposit (Whetstone 2015a).

3.1.3.3.3 Acid-Base Accounting Analysis

Acid rock drainage (ARD) is produced when sulfide minerals chemically react with oxygen and water to produce sulfuric acid and other reaction products. Many metals are more soluble under acidic conditions, and the formation of ARD can result in increased metal mobility in groundwater and surface water. Acid produced by the oxidation of sulfide minerals can be neutralized by a number of reactions involving carbonate mineral and basic silicates (Morin and Hutt 1994). Reactions with carbonates minerals are typically more effective at neutralizing ARD than reactions with silicate minerals. The potential for ARD formation can be minimized by using appropriate engineering practices, such as concurrent reclamation and capping to reduce the availability of oxygen and water for the reaction.

ABA testing provides a screening-level evaluation of the net acid-producing potential of rock by comparing the total acid generating potential (AGP) of the material to the acid neutralizing potential (ANP) of the material. According to BLM guidelines, the ratio of ANP to AGP is used to evaluate ABA data (BLM 1996). Rocks with ANP:AGP ratios greater than 3 are considered to have low potential to produce acidic drainage. ANP:AGP ratios between 3 and 1 are indeterminate, and ratios below 1 are potentially acid generating.

Results of the ABA analyses indicated that overburden and ore from the proposed Rasmussen Valley Mine have low potential to produce ARD. Average ANP:AGP ratios for the tested rock types ranged from 3.6:1 to 931.7:1 and are summarized in **Table 3.1-5**. **Figure 3.1-7** shows the percentages of each tested rock type broken out by the recommended BLM threshold values.

A review of the sulfur speciation data from the ABA analyses indicates that sulfate and organic sulfur form significant fractions of the total sulfur content of the tested material (**Table 3.1-6**). Organic sulfur does not participate in reactions that generate acidity (Casagrande et al. 1989) and was subtracted from the ABA values presented in **Table 3.1-5**. Based on the mineralogical analyses, sulfate sulfur may be associated with acid producing minerals such as jarosite. The calculated ANP:AGP ratios assume that sulfate sulfur is pyritic. This assumption is conservative because sulfate mineral reactions produce less acidity than reactions involving pyrite.

ABA results for Rasmussen Valley rocks are consistent with regional data for the Southeast Idaho Phosphate District. Whetstone (2009) compiled the results of 613 tests completed for several other phosphate mining sites in the region, including 19 tests from the Enoch Valley Mine, 61 tests from the Dry Valley Mine, 151 tests from the North Rasmussen Ridge Mine, and 382 test from the Smoky Canyon Mine, and determined that the average regional ANP:AGP ratio was 240:1. The median value of the regional data set exceeded the BLM criterion for material that has low potential to produce ARD by a factor of 10. The regional results and the ABA data from the

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Table 3.1-4 Comparison of the Average ICP-AES/MS Elemental Content of Rasmussen Valley Rocks with World Shale Averages (mg/kg)

Parameter	WSA	ALV	BST	DCS	REX	HWM	UO	UOP	CW	LO	LOP	FWM	GDT	WEL
Aluminum	80,000	16,536	15,167	11,561	3,435	13,796	11,340	11,988	9,630	8,132	5,380	10,494	1,275	2,923
Antimony	1.2	**1.5**	0.2	0.4	0.5	**1.4**	**3.7**	**1.7**	**5.5**	**6.8**	**4.1**	**2.6**	0.4	0.5
Arsenic	13	7.2	1.8	9.0	4.5	**14.7**	11.0	**14.2**	**24.8**	**17.9**	**14.2**	**16.8**	3.2	4.9
Barium	550	132	143	50	147	47	66	57	64	59	37	28	6	15
Beryllium	3	1.12	0.28	0.71	0.29	0.94	1.57	0.92	1.34	1.67	0.78	0.90	0.13	0.25
Boron	100	21	<10.	37	15	66	52	60	33	30	8	31	<5.	<10.
Cadmium	0.3	**26.8**	**1.86**	**2.47**	**2.31**	**14.38**	**108**	**36.7**	**22.29**	**141**	**80.3**	**88.8**	**14.38**	**15.64**
Calcium	22,100	**88,953**	14,667	15,207	15,012	**36,385**	**221,167**	**143,417**	**134,250**	**226,333**	**217,667**	**121,863**	**185,833**	**142,783**
Chromium	90	**226**	60	**304**	**101**	**346**	**743**	**387**	**680**	**797**	**383**	**308**	40	28
Copper	42	39	33	41	31	**46**	**62**	35	**77**	**99**	**43**	**45**	4	12
Iron	47,200	16,901	**59,883**	17,924	7,833	15,206	7,190	13,308	14,907	5,988	5,102	9,468	1,708	5,195
Lead	25	9.20	2.24	5.53	2.83	7.57	9.82	8.39	7.93	12.2	6.80	9.67	1.19	3.01
Magnesium	15,000	**19,247**	**17,017**	3,429	432	5,738	3,783	4,033	15,609	5,511	**49,456**	**44,125**	**112,511**	**56,817**
Manganese	850	469	**1,013**	128	41	174	76	213	167	40	98	179	115	275
Molybdenum	2.6	**4.6**	1.2	**3.8**	**4.6**	**16.6**	**18.0**	**11.5**	**31.4**	**40.7**	**21.1**	**58.4**	2.4	2.5
Nickel	68	67	45	**111**	37	**141**	**105**	**97**	**246**	**219**	**151**	**434**	46	**87**
Phosphorus	700	**22,624**	**2,983**	**5,350**	**2,865**	**13,423**	**100,050**	**62,483**	**37,205**	**96,244**	**53,644**	**18,025**	**4,230**	**3,833**
Potassium	26,600	3,153	767	3,836	1,082	3,785	3,250	2,900	2,859	3,411	1,911	3,613	271	1,017
Selenium	0.6	**4.88**	**0.69**	**20.6**	**15.1**	**68.0**	**44.1**	**21.4**	**139**	**127**	**63.0**	**57.3**	**2.9**	**3.59**
Silver	0.19	**1.43**	**0.20**	**0.31**	**0.33**	**1.72**	**5.45**	**2.69**	**5.49**	**11.94**	**5.51**	**2.36**	0.18	0.18
Sodium	9,600	935	2,600	261	310	369	983	733	832	2,411	922	1,013	388	262
Strontium	300	218	65	61	72	128	**540**	**348**	**546**	**753**	**449**	201	97	82
Thallium	1.4	0.85	0.20	0.30	0.22	0.83	**3.17**	**2.68**	0.65	**4.03**	**2.62**	**8.52**	0.29	1.06
Uranium	3.7	**29.9**	0.70	**6.87**	**8.26**	**21.3**	**96**	**49.3**	**24.0**	**106**	**57.3**	**22.1**	**6.02**	**4.70**
Vanadium	130	**235**	89	52	39	**111**	**646**	**259**	**185**	**1,240**	**622**	**920**	44	54
Zinc	100	**471**	**118**	**371**	**106**	**584**	**1,248**	**948**	**1,215**	**2,033**	**1,647**	**4,298**	**348**	**545**

Notes:

1 Bold values are values that exceed world shale average (WSA) values from Erickson 1973, Rose et al. 1979, and Turekian and Wedepohl 1961.

2 Abbreviations: ALV = alluvium, BST = basalt, DCS = Cherty Shale, REX = Rex Chert, HWM = hanging wall mud, UO = upper ore, UOP = upper ore partings CWS = center waste, LO = lower ore, LOP = lower ore partings, FWM = footwall mud, GTD = Grandeur Tongue, WEL = Wells Formation, mg/kg = milligrams per kilogram

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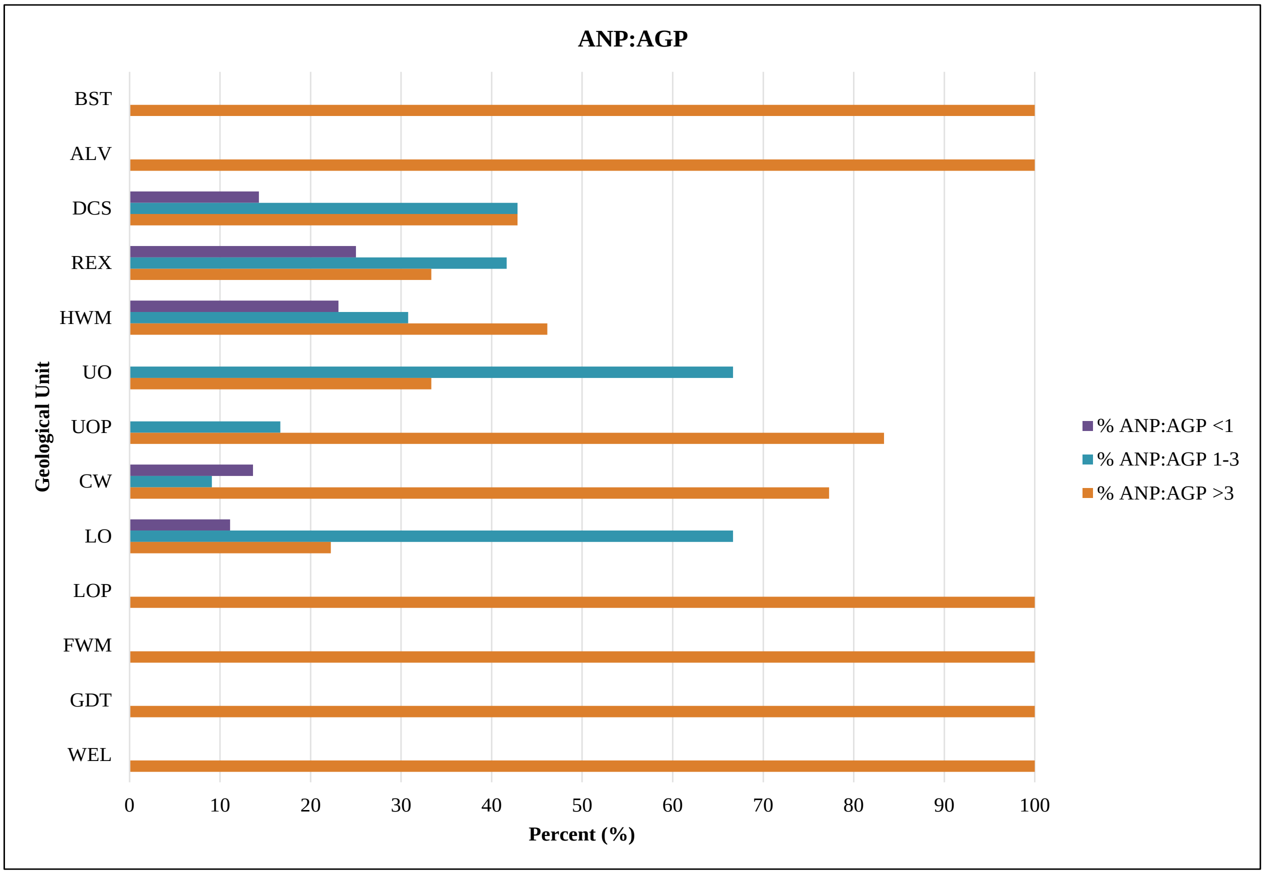
Rasmussen Valley baseline geochemistry study are consistent with the observation that phosphate mining has occurred in the district for about 90 years with only isolated reports of overburden-associated seepage with pH below 6.0 s.u.

Table 3.1-5 Average ABA Results for Rasmussen Valley Rocks

	AGP[1] (t $CaCO_3$/Kt)	ANP (t $CaCO_3$/Kt)	NNP[1] (t $CaCO_3$/Kt)	ANP:AGP[1]
Alluvium	3	154	151	116.5
Basalt	<1	20	19	20.3
Cherty Shale	12	35	24	9.1
Rex Chert	7	9	4	3.6
Hanging Wall Mud	26	61	35	3.8
Upper Ore	9	64	55	7.9
Upper Ore Partings	9	102	93	14.0
Center Waste	39	238	199	23.5
Lower Ore	18	99	81	5.9
Lower Ore Partings	7	475	469	159.8
Footwall Mud	9	416	406	256.8
Grandeur Tongue	<1	932	931	931.7
Wells Formation	1	579	578	487.5

Notes:
1 AGP calculated based on total sulfur minus organic sulfur
Abbreviations: AGP = acid generating potential, ANP = acid neutralizing potential, NNP = Net Neutralization Potential, t $CaCO_3$/Kt = tons calcium carbonate equivalent per kiloton of material

Figure 3.1-7 Percentage of Tested Samples by ANP:AGP Ratio



Abbreviations: BST = Basalt, ALV = Alluvium, DCS = Dark Cherty Shale, REX = Rex Chert, HWM = Hanging Wall Mud, UO = Upper Ore, UOP = Upper Ore Partings, CW = Center Waste, LO = Lower Ore, LOP = Lower Ore Partings, FWM = Footwall Mud, GDT = Grandeur Tongue, WEL = Wells Formation

Table 3.1-6 Average Sulfur and TOC Content of A-Composite Samples

	Organic Sulfur (%)	Pyritic Sulfur (%)	Sulfate (%)	Total Sulfur (%)	TOC[1] (%)
Alluvium	0.04	0.02	0.08	0.13	0.8
Basalt	<0.01	<0.01	0.01	0.01	0.1
Cherty Shale	0.08	0.30	0.06	0.45	2.2
Rex Chert	0.05	0.19	0.03	0.26	0.9
Hanging Wall Mud	0.24	0.72	0.11	1.07	2.6
Upper Ore	0.39	0.20	0.09	0.68	4.3
Upper Ore Partings	0.22	0.22	0.07	0.51	2.3
Center Waste	0.61	0.88	0.37	1.85	5.9
Lower Ore	0.64	0.34	0.24	1.22	5.5
Lower Ore Partings	0.23	0.17	0.05	0.45	2.1
Footwall Mud	0.25	0.23	0.08	0.54	2.0
Grandeur Tongue	0.01	0.01	<0.01	0.01	0.2
Wells Formation	0.02	0.03	0.01	0.03	0.1

Note:
1 TOC = total organic carbon

3.1.4 Paleontology

Sedimentary rocks of southeastern Idaho contain paleontological resources consisting of vertebrate, invertebrate, and plant fossils. Although some of the known types of fossils found in the Study Area are found elsewhere in southeastern Idaho, all fossils represent unique data concerning paleoecology and evolution.

The Potential Fossil Yield Classification (PFYC) system (BLM 2007) is used to provide baseline guidance for predicting, assessing, and mitigating impacts to fossils. Using the PFYC system, geologic units are classified based on the relative abundance of vertebrate fossils and traces (skin impressions, footprints, burrows) or scientifically significant invertebrate or plant fossils and their sensitivity to adverse impacts. A higher PFYC number indicates a higher potential for finding scientifically significant paleontological resources. A fossil is considered scientifically significant if it is a rare or previously unknown species, is of high quality and well preserved, preserves a previously unknown anatomical or other characteristic, provides new information about the history of life on earth, or has an identified educational or recreational value. On the other hand, a fossil may be considered to lack scientific significance if it lacks geologic context or physical integrity, or is commonly found and not useful for research (BLM 2007). Although significant localities (identified locations where large numbers of scientifically significant fossils or traces are found) may occasionally occur in a geologic unit, a few widely scattered important fossils or localities do not necessarily indicate a higher class; instead, the relative abundance of significant localities is intended to be the major factor in determining the class.

Table 3.1-7 summarizes the known fossil resources present within Study Area geologic units, their PFYC ratings as previously determined by BLM, where applicable, and their surface distribution within the Study Area. Units with low or very low potential to contain scientifically significant fossils (e.g., basalt) are not discussed.

Table 3.1-7 Summary of Fossil Resources Associated with Geologic Units Present in the Study Area

Geologic Unit	Known Fossil Resources	PFYC Ranking[1]	Study Area Acres
Thaynes Formation	Clams, snails, brachiopods, crinoids, crustaceans, sponges, *hybodontidae* shark teeth, *cestriacont* shark spines, acantodiform and paleonisciform fish, and ichthyosaur (*Cymbospondylys*) vertebrae Ammonoid-rich zone near base of formation	5a	9
Dinwoody Formation	Clams, ammonites, snails, and brachiopods.	3a	54
Phosphoria Formation – Meade Peak Member[3]	Brachiopods, snails, bivalves, ammonoids, isolated fish scales[2], fragmentary articulated fish, and tooth whorls of the giant shark *Helicoprion*.	5a	95
Wells Formation	Snails, clams, brachiopods, bryozoans, and rare corals in upper Permian units. Branching bryozoans and brachiopod (*Spirifer occidentalis*) in lower Pennsylvanian units.	3a	716
Alluvium	Mammoths, mastodons, horses, bison, camels, ground sloths, carnivores, ferrets, rodents, and other animals.	3b[3]	221

Notes:
1 PFYC potential for encountering scientifically significant fossil resources: Class 3a = Moderate; 3b = Moderate-Unknown; 5a = Very High-Exposed.
2 Commonly at the base of the Meade Peak Member is a fossiliferous phosphorite referred to as the "Fish Scale Marker Bed". Predictably, fish scales are more common in this bed but could be found isolated throughout the formation.
3 Other members of the Phosphoria Formation are not recognized fossil-producing geological units (BLM 2009).
4 Quaternary alluvial deposits are typically considered PFYC Class 3b deposits, particularly when vertebrate fossils have been recovered from similar deposits in the region but the area of concern has not been surveyed.
Source: Modified from BLM 2009, except alluvium.

3.2 AIR RESOURCES, CLIMATE, AND NOISE

3.2.1 Air Quality

3.2.1.1 Existing Pollutant Emission Sources

The Study Area is located 18 miles northeast of Soda Springs, Idaho. Locally, the topography is characterized by a series of north- to northwest-trending mountain ranges separated by broad intermountain valleys. The Study Area is located between the Wooley Range and Rasmussen Ridge in Rasmussen Valley. Elevation ranges from 6,480 feet to 7,020 feet. Rasmussen Ridge is at an elevation of approximately 7,000 feet.

The Study Area is located in a rural area where gaseous pollutant concentrations are expected to be low. Existing sources of air pollution in and near the Study Area include mining, ranching, and recreation. The closest sources of air pollution are within 20 miles of the Study Area. The Blackfoot Bridge Mine is located 8 miles southwest of the Study Area. The Rasmussen Ridge Mine is located north within 5 miles of the Study Area. The South Rasmussen Mine within the northern portion of the Study Area is in the process of reclamation. The Smoky Canyon Mine is located 12 miles southeast of the Study Area. Soda Springs, which is located 18 miles southwest of the Study Area, is a source of air pollution which includes the Agrium's Conda Phosphate Operations (CPO) Fertilizer Manufacturing Plant. Phosphate processing occurs near Soda

Springs. Air pollution from mining includes fugitive dust from paved and unpaved roads and gaseous emissions from combustion sources.

The Clean Air Act, last amended in 1990, establishes National Ambient Air Quality Standards (NAAQS) for six principal pollutants, called “criteria” pollutants, which are considered harmful to public health and the environment. The criteria pollutants include carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter 10 microns or less in diameter (PM_{10}), particulate matter 2.5 microns or less in diameter ($PM_{2.5}$), and sulfur dioxide (SO_2). **Table 3.2-1** identifies the NAAQS. The State of Idaho adheres to the NAAQS (Idaho Department of Environmental Quality [IDEQ] 2010).

Table 3.2-1 NAAQS and State of Idaho Air Quality Standards

Pollutant (final rule citation)		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide (76 FR 54294, Aug 31, 2011)		primary	8-hour	9 ppm	Not to be exceeded more than once per year
			1-hour	35 ppm	
Lead (73 FR 66964, Nov 12, 2008)		primary and secondary	Rolling 3-month average	0.15 μg/m^{3}[1]	Not to be exceeded
Nitrogen Dioxide (75 FR 6474, Feb 9, 2010) (61 FR 52852, Oct 8, 1996)		primary	1-hour	100 ppb	98th percentile, averaged over 3 years
		primary and secondary	Annual	53 ppb[2]	Annual Mean
Ozone (73 FR 16436, Mar 27, 2008)		primary and secondary	8-hour	0.075 ppm[3]	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particle Pollution Dec 14, 2012	$PM_{2.5}$	primary	Annual	12 μg/m^3	annual mean, averaged over 3 years
		secondary	Annual	15 μg/m^3	annual mean, averaged over 3 years
		primary and secondary	24-hour	35 μg/m^3	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24-hour	150 μg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (75 FR 35520, Jun 22, 2010) (38 FR 25678, Sept 14, 1973)		primary	1-hour	75 ppb[4]	99th percentile of 1-hour daily max. concentrations, averaged over 3 years
		secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

Notes:

1 Final rule was signed October 15, 2008. The 1978 lead standard (1.5 μg/m^3 as a quarterly average) remains in effect until 1 year after an area is designated for the 2008 standard, except that, in areas designated non-attainment for the 1978, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

2 The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.

3 Final rule signed March 12, 2008. The 1997 ozone standard (0.08 ppm, annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years) and related implementation rules remain in place. In 1997, the U.S. Environmental Protection Agency (USEPA) revoked the 1-hour ozone standard (0.12 ppm, not to be exceeded more than once per year) in all areas, although some areas have continued obligations under that standard (“anti-backsliding”). The 1-hour ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations higher than 0.12 ppm is less than or equal to 1.

4 Final rule was signed June 2, 2010. The 1971 annual and 24-hour SO_2 standards were revoked in that same rulemaking. However, these standards remain in effect until 1 year after an area is designated for the 2010 standard, except in areas designated non-attainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.

Abbreviations: ppb = parts per billion, ppm = parts per million, μg/m^3 = micrograms per cubic meter

Source: USEPA 2014

3.2.1.2 Regional Air Quality

The Proposed Action is located within an area designated as an Attainment area. A geographic area that meets or has pollutant levels below the NAAQS is called an Attainment area. An area with persistent air quality problems is designated a Non-attainment area, and means that activities in the area have violated federal health-based standards. The closest Non-attainment area is for $PM_{2.5,}$ particulates, located at Cache Valley, 30 miles south of the Study Area. The Fort Hall area is classified Non-attainment for PM_{10} particulates and is 40 miles west of the Study Area. The Caribou County Air Quality Index rating has been rated good in 2005, meaning that air quality is satisfactory, and air pollution poses little or no risk to public health or the environment (IDEQ 2012a).

The Idaho Department of Health and Welfare has collected air quality monitoring data at the Norton Site near Soda Springs, Idaho. PM_{10} particulates data were collected at the site from 1990 through 1995. The annual average concentration ranged from 20.1 to 31.6 micrograms per cubic meter (µg/m^3) during that period. The 24-hour NAAQS for PM_{10} particulates is 150 µg/m^3. The 24-hour maximum for PM_{10} particulates was exceeded once in 1992 (BLM 2003a).

The Idaho Air Monitoring Network Plan has a nearby site in Soda Springs, 15 miles southwest of the Study Area, located next to the P4 Processing Plant. This monitoring site has provided 1-hour continuous SO_2 data since 2002. Initially, the monitoring objective was to assess SO_2 NAAQS for industrial impacts from a nearby source in Caribou County (IDEQ 2012b). Soda Springs has historically been affected by industrial SO_2.

Consequently, a major project to desulfurize flue gas from the source was implemented in 2001, and SO_2 emissions dropped to well below the annual, 24-hour, and 3-hour NAAQS. In 2002, one SO_2 monitor was shut down, and a site located near a phosphorous plant became the primary monitoring location. The objective was then changed from population-based monitoring to hot-spot monitoring. From 2007 through 2009, the short-term SO_2 concentrations remained well below the level of the three old SO_2 NAAQS and the new 1-hour SO_2 NAAQS of 75 parts per billion (ppb; IDEQ 2010). No air quality exceedances of SO_2 were recorded for 2010, the last year reported (IDEQ 2012a).

Agrium currently operates the CPO Plant, 5 miles north of Soda Springs, Idaho on State Route 34. The facility has been in operation since at least the 1960s. Raw phosphate is processed to produce fertilizer products at the plant. This plant operates under Idaho Air Quality Tier 1 Operations Permit number 029-00003 (DKL 2015). IDEQ tracks emissions from the facility. Under a Tier 1 permit, operators are required to comply with the conditions of the permit and report the status of compliance. Emissions generated by the sulfur burning plant are approximately 4 pounds (lb.) of SO_2 and 0.15 lb. of acid mist per ton of material processed. Based on the air quality monitoring data collected by the nearby monitoring station as described above, the short-term SO_2 emissions remain below the NAAQS (IDEQ 2012a).

Federal Prevention of Significant Deterioration (PSD) regulations limit the maximum allowable incremental increase in Class I, Class II, and Class III areas. PSD applies to new major sources or major modifications at existing sources for pollutants located in an area that is in Attainment or unclassifiable with the NAAQS. The level of deterioration allowed within a Class I PSD area is lower than that for Class II designated areas, resulting in standards that are more stringent. Class I areas include all national parks larger than 6,000 acres, wilderness areas and national memorial parks larger than 5,000 acres, and certain international parks.

The Study Area is located within a Class II area (IDEQ 2012a), which allows moderate degradation of air quality within certain prescribed limits above baseline levels. Before an industrial facility, such as a mine, can locate or expand within a Class II area, it must demonstrate that the increase in emissions associated with the facility would not cause degradation of air quality in all classified areas and would not cause degradation of visibility in Class I areas.

The Clean Air Act requires that Class I areas be evaluated for haze and visibility impacts if a new or a major-modification facility is planned. Within a 100-kilometer radius of the Study Area is the Grand Teton National Park, Class I area (IDEQ 2014a). Environmental practices for evaluation of impacts to air resources shall be considered for the airshed (generally the surrounding airshed within 100 kilometers) as well as written notification of the new source to the Federal Land Managers for that area (National Park Service [NPS] 2010). In addition, a major action (e.g., construction) is also subject to visibility and hazard impact analyses. The distances and directions to the nearest Class I areas are presented in **Table 3.2-2**.

Table 3.2-2 Federal Mandatory Class I Areas Nearest to Study Area

Area	Direction From Project	Distance From Project (Miles)
Grand Teton National Park	Northeast	55
Bridger Wilderness Area	East	72
Yellowstone National Park	North	88
Teton Wilderness Area	Northeast	83
Fitzpatrick Wilderness Area	Northeast	87
Craters of the Moon National Monument	Northwest	86

Source: IDEQ 2014a

The Clean Air Act authorized the U.S. Environmental Protection Agency (USEPA) to develop technology-based standards that apply to specific categories of stationary sources. These standards are referred to as New Source Performance Standards (NSPS) and apply to new, modified, and reconstructed affected facilities in specific source categories. The NSPS were developed and implemented by the USEPA and are delegated to the states. Sources subject to NSPS are required to perform an initial performance test to demonstrate compliance. To demonstrate continuous compliance, some NSPS require sources to monitor emissions continuously.

Federal Operating Permits (Title V permits) are required for facilities with the potential to emit more than 100 tons per year of a regulated pollutant, 10 tons per year of any single hazardous air pollutant, or 25 tons per year of any combination of hazardous air pollutants.

3.2.2 Noise

Noise is generally described as unwanted sound. Discussions of environmental noise do not focus on pure tones because commonly heard sounds have complex frequency and pressure characteristics. Accordingly, sound measurement equipment has been designed to account for the sensitivity of human hearing to different frequencies. Correction factors for adjusting actual sound pressure levels to correspond with human hearing have been determined experimentally. For measuring noise in ordinary environments, A-weighted correction factors are employed. The filter de-emphasizes the very low and very high frequencies of sound in a manner similar to the response of the human ear. Therefore, the A-weighted decibel (dBA) is a good correlation to a human's subjective reaction to noise.

The dBA is measured on a logarithmic scale. To the average human ear, the apparent increase in "loudness" doubles for every 10 dBA increase in noise (Bell 1982).

Equivalent noise level (L_{eq}) values are used to develop single-value descriptions of average noise exposure over various periods. Such average ratings for noise exposure often include additional weighting factors for potential annoyance because of time of day or other considerations. The L_{eq} data used for describing average noise exposure generally are based on A-weighted sound level measurements. L_{eq} are not an averaging of decibel values. High dB events contribute more to the L_{eq} value than low dB events.

Average noise exposure over a 24-hour period is often presented as a day-night average sound level (L_{dn}). L_{dn} values are calculated from hourly L_{eq} values, with the L_{eq} values for the nighttime period (10 p.m. to 7 a.m.) increased by 10 dB to reflect the greater disturbance potential from nighttime noises. **Table 3.2-3** shows examples of day-night average noise levels generated in land use areas.

Table 3.2-3 Examples of Outdoor Day-Night Average Sound Levels in dB Measured at Various Locations

Noise Location	L_{dn} Sound Level (dB)
Apartment next to a freeway	87.5
Urban high density apartment	78
Urban row housing on major avenue	68
Wooded residential	51
Agricultural crop land	44
Rural residential	39
Wilderness ambient	35
Eagle Mine	39 - 52
Humboldt Mill	35 - 47

Source: USEPA 1978, TRIMEDIA 2014

For comparison, the noise level experienced during normal conversation between two people 5 feet apart is 60 dBA.

The USEPA has identified outdoor levels of 55 dBA L_{dn} and L_{eq} as desirable to protect against interference and annoyance where people spend widely varying amounts of time in sensitive areas, such as residences and other places, where quiet is a basis for use. Outdoor sites are generally unacceptable if exposed to sound levels of 70 dBA L_{eq} or higher (USEPA 1974).

3.2.2.1 Existing Noise Levels

Existing noise levels in the Study Area are low. The Study Area is located in a rural area with a low density of residences. Based on **Table 3.2-3**, background ambient noise levels in the Study Area would range from 35 to 52 dBA. Noise from nearby phosphate mining operations, such as Rasmussen Ridge, South Rasmussen, Blackfoot Bridge, and Smoky Canyon, are within 12 miles of the Study Area, which cumulatively would contribute to ambient noise.

3.2.2.2 Existing Regulations

A review of the Idaho Statutes and Soda Springs municipal codes did not reveal any noise regulations. There are no national noise regulations. In the Noise Control Act of 1972, Congress directed the USEPA to publish scientific information on the effects of different qualities and quantities of noise and to define acceptable noise levels under different conditions that would protect public health and welfare with an adequate margin of safety. The USEPA published "Information on Levels of Environment Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety" in 1974 (USEPA 1974). This guidance document is not a standard, specification, or regulation. The document provides a summary of noise levels identified to be protective of public health and welfare in indoor settings and "outdoors in residential areas and farms and other outdoor areas where people spend widely varying amounts of time and other places in which quiet is a basis for use". The outdoor level is 55 dBA L_{dn}. The USEPA also provides a level of 55 dBA L_{eq} for outdoor areas where people spend limited amounts of time, such as schoolyards and playgrounds. For all areas, USEPA (1974) recommends that 24-hour noise exposure should not exceed 70 dBA_{eq}.

3.2.2.3 Locations of Sensitive Receptors Identified

Sensitive receptors include residences, schools, medical facilities, and recreational areas. The closest populated area is the small, unincorporated Town of Wayan, which is located 7.6 miles north of the Study Area. The closest seasonal residence is located 0.5 mile south of the Study Area and east of Diamond Creek Road. The next closest residence (also seasonal) is located 0.64 mile from the Study Area and east of Blackfoot River Road. There is a grouping of nine residences located 1.17 to 1.30 miles northeast of the Study Area. The Blackfoot River Wildlife Management Area (WMA) overlaps the south end of the Study Area.

3.2.3 Climate

3.2.3.1 Current Climate

The climate of the Study Area is semi-arid, and local patterns of wind, precipitation, and temperature are influenced by prominent geographic features, including Blackfoot Reservoir and the Wooley Range.

A study of the climate for the Study Area was assessed using a Parameter-elevation Regressions on Independent Slopes Model (PRISM) with 12 local meteorological data sets. The operators of the 12 meteorological stations include the National Weather Service (NWS), Remote Automated Weather Station (RAWS), Natural Resource Conservation Service (NRCS), and Snow Telemetry (SNOTEL). The weather stations are located within a 6.3- to 64.4-mile range of the Study Area (Whetstone 2014).

The climate summary for the Study Area for the period 1981 through 2013 suggests that the area experiences variations in temperature across the site associated with elevation and geographic differences. Area-weighted averages were calculated to account for the spatial variation in temperature. Average monthly temperatures range from 61.7 degrees Fahrenheit (ºF) in July to 19.4ºF in December. Normally, May is the wettest month of the year, with an average precipitation of 2.74 inches. The average annual precipitation is 23.41 inches. Winds blow predominantly from the southwest (Whetstone 2014). The average annual snowfall is 50 inches (WRCC 2014). Climate summary data by month from the Study Area are summarized in **Table 3.2-4**.

The Diamond Flat RAWS station is the closest public meteorological station to the Study Area (6.3 miles east) and presents the best available data to characterize the existing winds for the Study Area. The Diamond Flat station is located in the Webster Range adjacent to the Grays Range. Winds are predominantly from the southwest, with wind speeds averaging 2.1 miles per hour (mph); 50 percent of the winds are calm and below 1.3 mph. **Figure 3.2-1** is a wind rose generated with 2010 to 2015 Diamond Flat station data, which illustrates estimated wind direction and speeds for the Study Area.

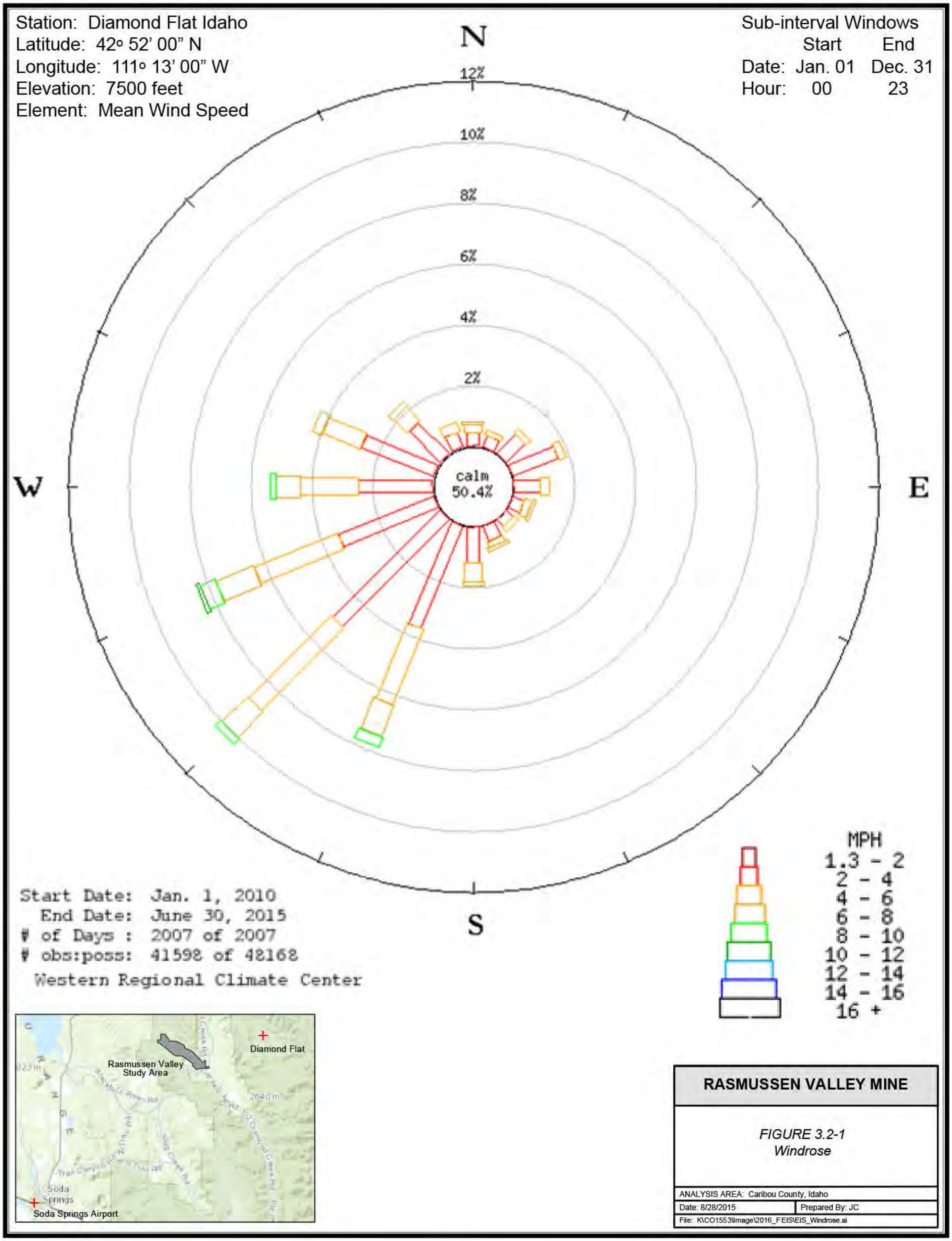


FIGURE 3.2-1
Windrose

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Table 3.2-4 Monthly Climate Summary for Rasmussen Valley Analysis Area

Period of Record : 1981 to 2013													
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Avg Temperature (ºF)	19.4	21.6	29.3	37.2	46.0	53.7	61.7	60.9	51.9	41.2	28.2	19.2	19.4
Avg Total Precipitation (in)	2.4	1.9	2.0	2.0	2.7	1.8	1.1	1.2	1.5	1.9	2.4	2.5	23.4
Avg Total Snow Fall (in)	11.7	8.6	7.3	3.7	0.5	0.1	0	0	0	0.9	6.7	10.6	50
Avg Snow Depth (in)	10	11	5	0	0	0	0	0	0	0	1	5	

Abbreviations: Avg = average ºF = degrees Fahrenheit, in = inches, Jan = January, Feb = February, Mar = March, Apr = April, Jun = June, Jul = July, Aug = August, Sep = September, Oct = October, Nov = November, Dec = December

Source: WRCC 2014; Whetstone 2014

3.2.3.2 Climate Change

Ongoing scientific research has identified the potential impacts of the “greenhouse effect” resulting from several types of greenhouse gasses (GHGs) in air including CO_2, methane, nitrous oxide, and several fluorinated trace gasses on global climate.

The National Climate Change Viewer Program, developed by the USGS, was used to model climate change for Caribou County, Idaho. Based on the USGS models, since 1950, the average minimum and maximum temperatures (measured at 2 meters above ground level) have risen 2.1°F. The predictive model projects an average minimum and maximum temperature increase of 4.7°F and 4.4°F, respectively, in the next 100 years (USGS 2014b).

The USEPA states that the earth’s average temperature has risen by 1.4°F over the past century and is projected to rise another 2 to 11.5°F over the next 100 years. Small changes in the average temperature of the planet can translate to large and potentially dangerous shifts in climate and weather (USEPA 2013).

According to the Intergovernmental Panel on Climate Change (IPCC), “warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased. Each of the last three decades has been successively warmer at the Earth’s surface than any preceding decade since 1850. In the Northern Hemisphere, 1983 to 2012 was likely the warmest 30-year period of the last 1,400 years (medium confidence).

“The atmospheric concentrations of carbon dioxide, methane, and nitrous oxide have increased to levels unprecedented in at least the last 800,000 years. Carbon dioxide concentrations have increased by 40 percent since pre-industrial times, primarily from fossil fuel emissions and secondarily from net land use change emissions. The ocean has absorbed about 30 percent of the emitted anthropogenic carbon dioxide, causing ocean acidification.

“Human influence on the climate system is clear. This is evident from the increasing greenhouse gas concentrations in the atmosphere, positive radiative forcing, observed warming, and understanding of the climate system.

“Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system. Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions” (IPCC 2013). These ongoing climate change trends may affect aspects of mine operation and reclamation success as discussed in **Section 4.2.1.1.2**.

3.3 WATER RESOURCES

3.3.1 Surface Water Resources

The Proposed Action is located within the Blackfoot Sub-Basin, a USGS 4th level Hydrologic Unit Code (HUC-4) sub-basin (17040207) that drains into the Snake River Basin. The analysis area is located in two of the 5th level HUCs (watersheds) within the sub-basin. The 5th level HUCs are further divided into three 6th level HUCs (sub-watersheds). **Table 3.3-1** lists the 5th and 6th level HUCs that are associated with the analysis area (**Figure 3.3-2**). Named surface water features within the analysis area include Blackfoot River, Lanes Creek, Diamond Creek, Angus Creek, Rasmussen Creek, Bacon Creek, Spring Creek, and Mill Canyon Creek (also referred to as East Mill Creek; **Figure 3.3-2**).

Table 3.3-1 Major Watersheds within the Study Area

Watershed (HUC 5)	Sub-Watershed (HUC 6)	Acres
Lanes Creek-Diamond Creek (HUC 1704020701)	Lower Lanes Creek (HUC 170402070102)	26,865
	Diamond Creek (HUC 170402070104)	25,214
	Subtotal	52,079
Upper Blackfoot River (HUC 1704020702)	Angus Creek-Blackfoot River (HUC 170402070205)	19,167
	Total	71,246

Within the analysis area, the watershed for Lanes Creek includes Bacon Creek, Upper Valley, and a relatively small portion of the southeast Study Area (**Figure 3.3-2**). Lanes Creek joins with Diamond Creek 0.5 mile southeast of the project boundary to form Blackfoot River. Spring Creek joins Blackfoot River 0.4 mile below its origin. Mill Canyon Creek is tributary to Spring Creek. The Blackfoot River meanders west then southwest as it crosses Rasmussen Valley before turning northwest toward Blackfoot Reservoir. Angus Creek drains the watershed for Rasmussen Valley including the Study Area on the southern flank of Rasmussen Ridge. Angus Creek is tributary to Blackfoot River 0.5 mile southwest of the project boundary. Rasmussen Creek is tributary to the upper reaches of Angus Creek. The southwestern flank of Rasmussen Ridge has six drainages in the Study Area that are mapped as having intermittent flow by the USGS (USGS 2011). The drainages are tributary to Angus Creek. The major watershed divides for the Study Area are shown on **Figure 3.3-1**. Several stock ponds and intermittent springs are located on the southwest flank of the ridge in the mid to upper portions of the drainages (**Figure 3.3-3**).

Primary commercial activities in the Blackfoot Sub-basin include agriculture, livestock grazing, and phosphate mining. Recreational uses include fishing and hunting. Streams within the analysis area support aquatic life and are used for agricultural water supply and recreational activities such as fishing salmonids.

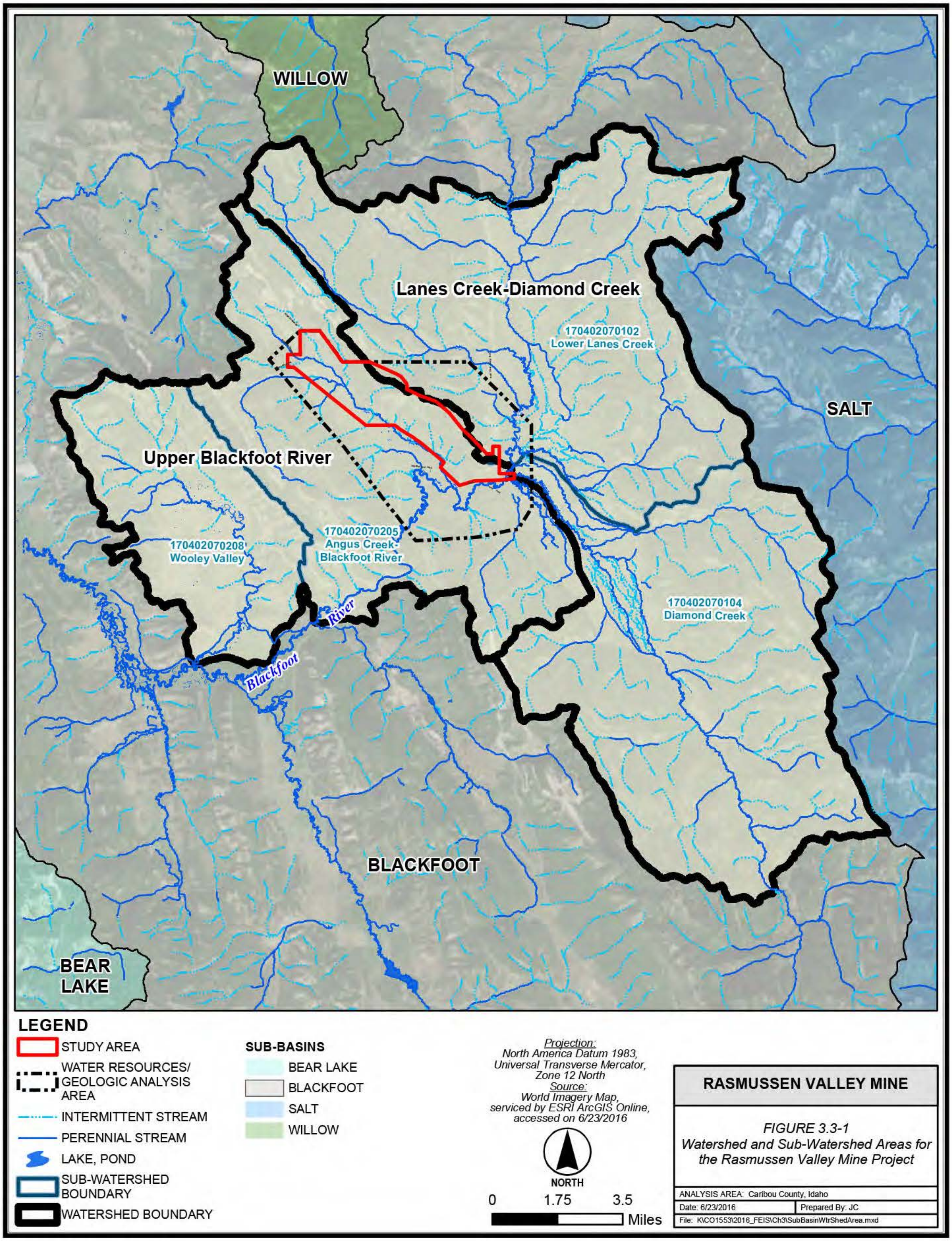
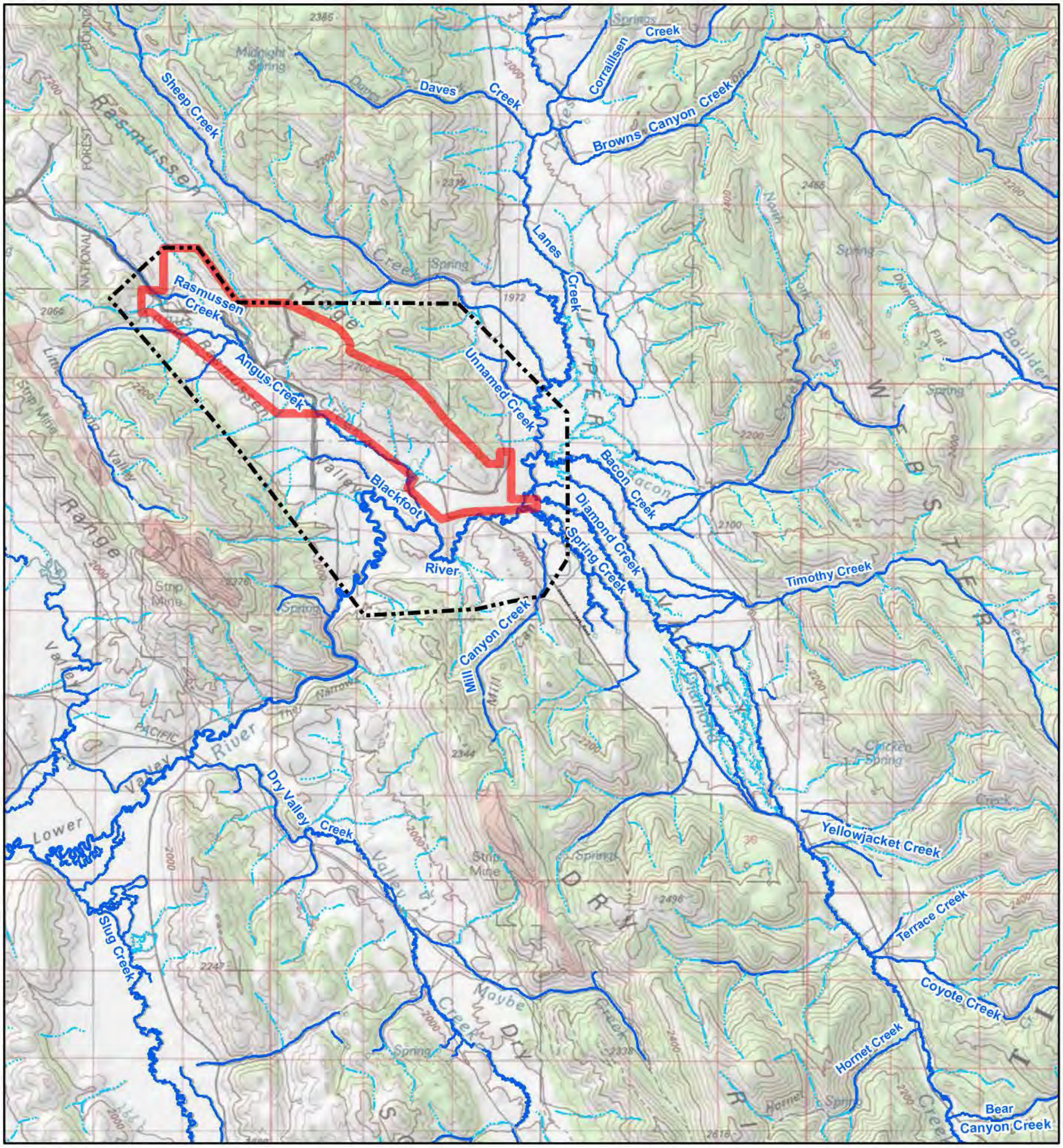


FIGURE 3.3-1
Watershed and Sub-Watershed Areas for the Rasmussen Valley Mine Project



LEGEND

STUDY AREA

WATER RESOURCES ANALYSIS AREA

INTERMITTENT STREAM

PERENNIAL STREAM

EXISTING ROAD

Projection:
North America Datum 1983,
Universal Transverse Mercator,
Zone 12 North
Source:
USA Topo Map,
serviced by ESRI ArcGIS Online,
accessed on 6/23/2016

NORTH

0 0.85 1.7 Miles

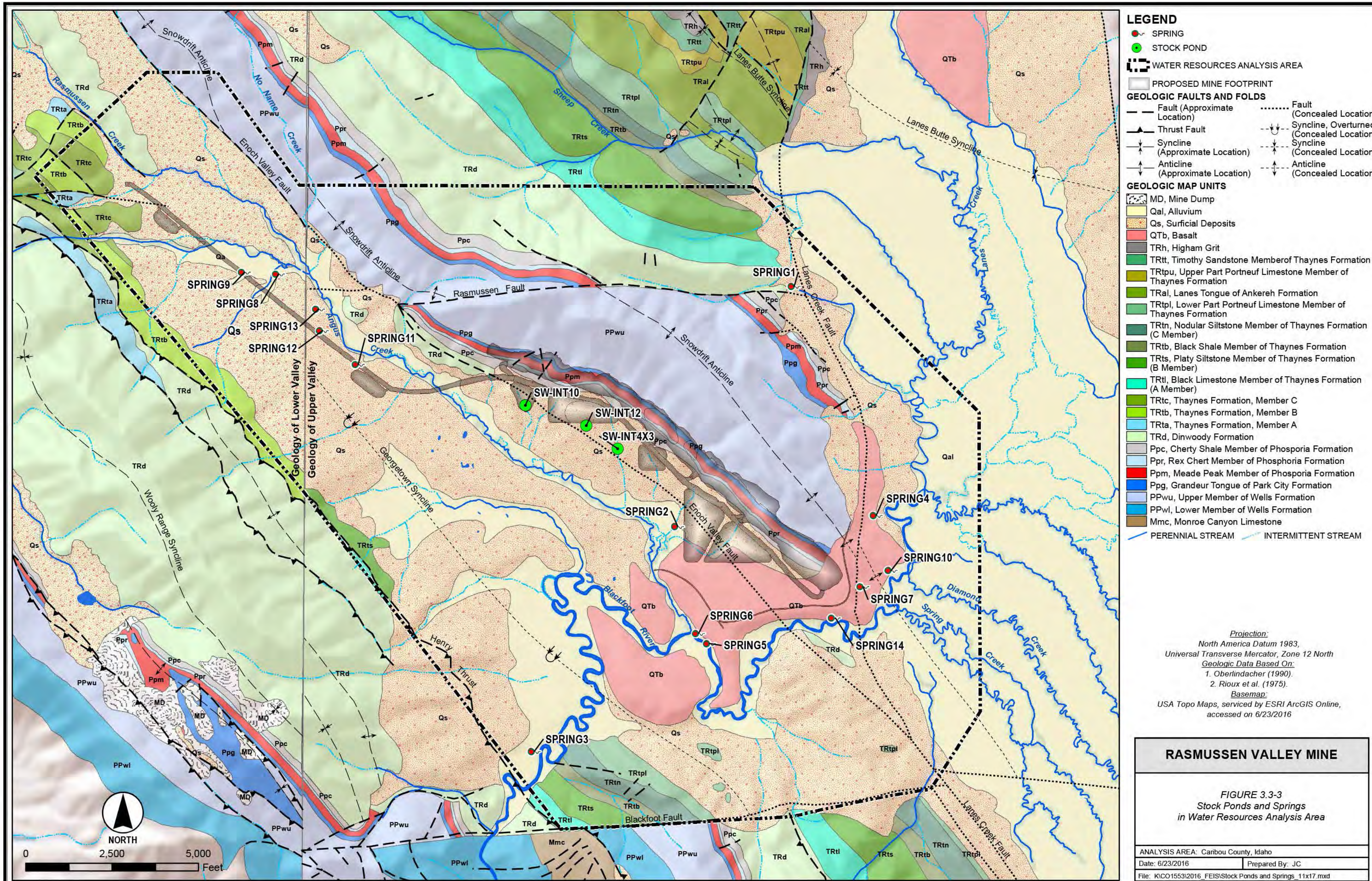
RASMUSSEN VALLEY MINE

FIGURE 3.3-2
Surface Water Features within or near the Water Resources Analysis Area

ANALYSIS AREA: Caribou County, Idaho

Date: 6/23/2016 | Prepared By: JC

File: K:\CO1553\2016_FEIS\Ch3\SWFeatures.mxd


LEGEND
SPRING
STOCK POND
WATER RESOURCES ANALYSIS AREA
PROPOSED MINE FOOTPRINT
GEOLOGIC FAULTS AND FOLDS
Fault (Approximate Location)
Fault (Concealed Location)
Thrust Fault
Syncline, Overturned (Concealed Location)
Syncline (Approximate Location)
Syncline (Concealed Location)
Anticline (Approximate Location)
Anticline (Concealed Location)
GEOLOGIC MAP UNITS
MD, Mine Dump
Qal, Alluvium
Qs, Surficial Deposits
QTb, Basalt
TRh, Higham Grit
TRtt, Timothy Sandstone Memberof Thaynes Formation
TRtpu, Upper Part Portneuf Limestone Member of Thaynes Formation
TRal, Lanes Tongue of Ankereh Formation
TRtpl, Lower Part Portneuf Limestone Member of Thaynes Formation
TRtn, Nodular Siltstone Member of Thaynes Formation (C Member)
TRtb, Black Shale Member of Thaynes Formation
TRts, Platy Siltstone Member of Thaynes Formation (B Member)
TRtl, Black Limestone Member of Thaynes Formation (A Member)
TRtc, Thaynes Formation, Member C
TRtb, Thaynes Formation, Member B
TRta, Thaynes Formation, Member A
TRd, Dinwoody Formation
Ppc, Cherty Shale Member of Phosporia Formation
Ppr, Rex Chert Member of Phosphoria Formation
Ppm, Meade Peak Member of Phosporia Formation
Ppg, Grandeur Tongue of Park City Formation
PPwu, Upper Member of Wells Formation
PPwl, Lower Member of Wells Formation
Mmc, Monroe Canyon Limestone
PERENNIAL STREAM
INTERMITTENT STREAM
Projection:
North America Datum 1983,
Universal Transverse Mercator, Zone 12 North
Geologic Data Based On:
1. Oberlindacher (1990).
2. Rioux et al. (1975).
Basemap:
USA Topo Maps, serviced by ESRI ArcGIS Online,
accessed on 6/23/2016
RASMUSSEN VALLEY MINE
FIGURE 3.3-3
Stock Ponds and Springs
in Water Resources Analysis Area
ANALYSIS AREA: Caribou County, Idaho
Date: 6/23/2016
Prepared By: JC
File: K:\CO1553\2016_FEIS\Stock Ponds and Springs_11x17.mxd
NORTH
0
2,500
5,000
Feet
SPRING1
SPRING2
SPRING3
SPRING4
SPRING5
SPRING6
SPRING7
SPRING8
SPRING9
SPRING10
SPRING11
SPRING12
SPRING13
SPRING14
SW-INT10
SW-INT12
SW-INT4X3
Snowdrift Anticline
Rasmussen Creek
No Name Creek
Sheep Creek
Lanes Butte Syncline
Enoch Valley Fault
Rasmussen Fault
Angus Creek
Lanes Creek Fault
Lanes Creek
Geology of Lower Valley
Geology of Upper Valley
Georgetown Syncline
Wooly Range Syncline
Henry Thrust
Blackfoot River
Blackfoot Fault
Diamond Creek
Spring Creek

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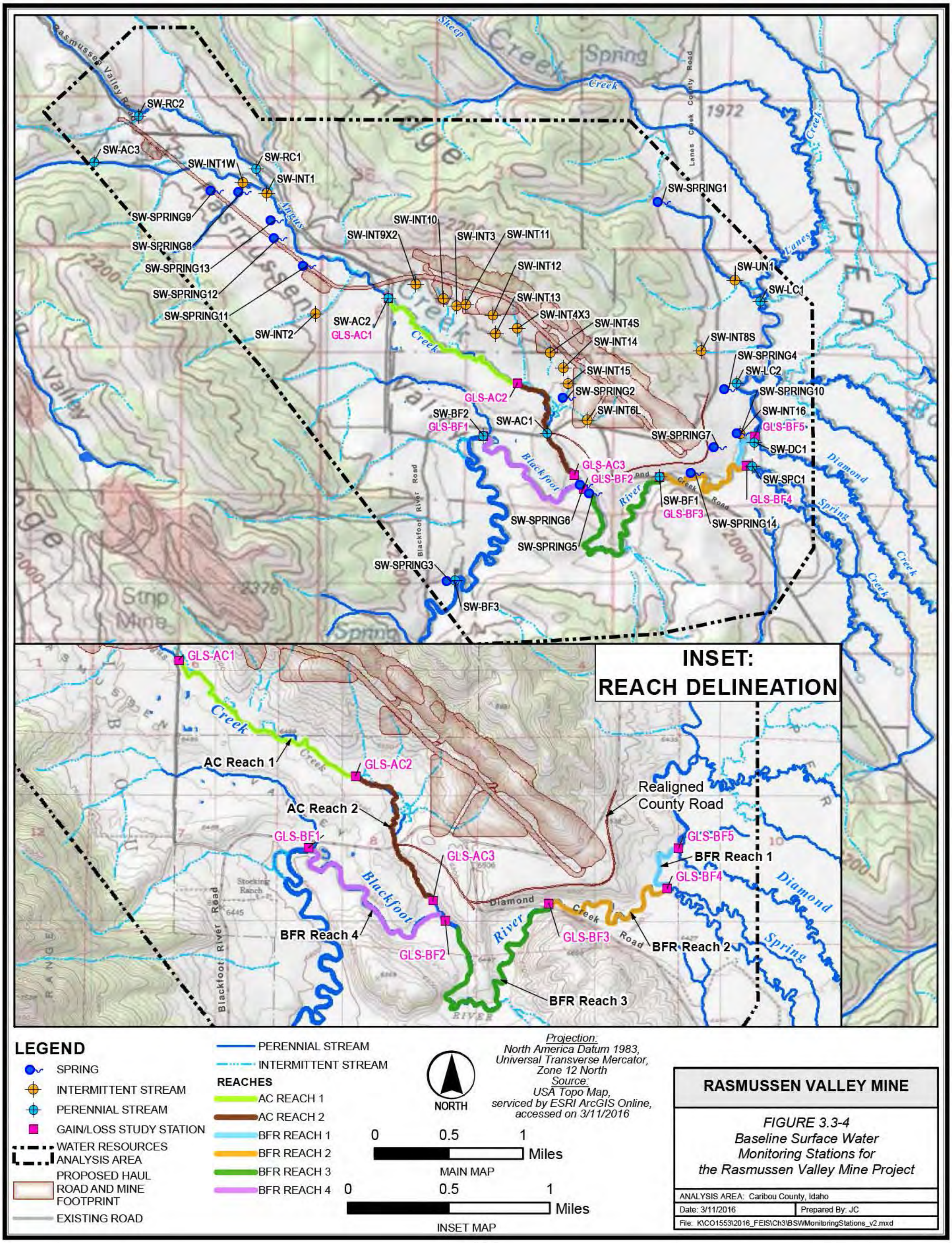
INSET:
REACH DELINEATION
SW-RC2
SW-AC3
SW-INT1W
SW-RC1
SW-INT1
SW-SPRING9
SW-SPRING8
SW-SPRING13
SW-SPRING12
SW-SPRING11
SW-INT2
SW-AC2
GLS-AC1
SW-INT9X2
SW-INT10
SW-INT3
SW-INT11
SW-INT12
SW-INT13
SW-INT4X3
SW-INT4S
SW-INT14
SW-INT15
SW-SPRING2
SW-INT6L
GLS-AC2
SW-BF2
GLS-BF1
SW-AC1
GLS-AC3
GLS-BF2
SW-SPRING6
SW-SPRING5
SW-SPRING3
SW-BF3
SW-SPRING1
SW-UN1
SW-LC1
SW-INT8S
SW-SPRING4
SW-LC2
SW-SPRING10
SW-INT16
GLS-BF5
SW-DC1
SW-SPRING7
SW-SPC1
GLS-BF4
SW-BF1
GLS-BF3
SW-SPRING14
AC Reach 1
AC Reach 2
BFR Reach 1
BFR Reach 2
BFR Reach 3
BFR Reach 4
Realigned County Road
LEGEND
SPRING
INTERMITTENT STREAM
PERENNIAL STREAM
GAIN/LOSS STUDY STATION
WATER RESOURCES ANALYSIS AREA
PROPOSED HAUL ROAD AND MINE FOOTPRINT
EXISTING ROAD
PERENNIAL STREAM
INTERMITTENT STREAM
REACHES
AC REACH 1
AC REACH 2
BFR REACH 1
BFR REACH 2
BFR REACH 3
BFR REACH 4
NORTH
0 0.5 1 Miles
MAIN MAP
0 0.5 1 Miles
INSET MAP
Projection:
North America Datum 1983,
Universal Transverse Mercator,
Zone 12 North
Source:
USA Topo Map,
serviced by ESRI ArcGIS Online,
accessed on 3/11/2016
RASMUSSEN VALLEY MINE
FIGURE 3.3-4
Baseline Surface Water
Monitoring Stations for
the Rasmussen Valley Mine Project
ANALYSIS AREA: Caribou County, Idaho
Date: 3/11/2016
Prepared By: JC
File: K:\CO1553\2016_FEIS\Ch3\BSWMonitoringStations_v2.mxd

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3.3.1.1 Baseline Surface Monitoring Network, Applicable Water Quality Standards, and Description of Waterbodies

Data for the Rasmussen Valley surface water analysis were compiled from public domain sources, including reports, maps, and databases prepared by governmental agencies, private entities, university researchers, non-governmental organizations. These data are supplemented by site-specific baseline studies completed between April 2010 and December 2014. Baseline surface water studies for Rasmussen Valley were prepared under the direction of the Agencies and included:

- Monitoring of 13 stream stations, 16 intermittent drainages, and 14 springs seven times annually starting in 2010
- Multiple gain-loss surveys on the upper Blackfoot River and lower Angus Creek

The locations of baseline surface water monitoring stations are shown on **Figure 3.3-4**. A complete description of the surface water baseline monitoring program is presented in the Rasmussen Valley Mine Project Baseline Water Resources Technical Report (Whetstone 2015b).

Water quality standards for surface water are contained in Idaho Administrative Procedures Act (IDAPA 58.01.02). According to IDAPA 58.01.02, streams and lakes are classified and managed by beneficial use. Designated beneficial uses for a water body may include warm or cold water aquatic life; salmonid spawning; seasonal cold-water or modified aquatic life; primary- or secondary-contact recreation domestic, agricultural, or industrial water supply; wildlife habitat; and aesthetics. If more than one beneficial use is recognized for a water body, the most stringent water quality standard is applicable. Standards for cold-water aquatic life, primary or secondary-contact recreation, agricultural water supply, industrial water supply, wildlife habitat, and aesthetics are applicable to all undesignated non-private surface water bodies in the State of Idaho. Water quality standards are not applicable to mine water management and impoundment facilities, such as sedimentation ponds and pit impoundments.

Blackfoot River has designated beneficial uses. These uses are cold-water aquatic life, salmonid spawning, primary-contact recreation, and domestic water supply. All other surface water bodies in the Study Area are undesignated, and applicable criteria include cold-water aquatic life and primary- or secondary-contact recreation (IDAPA 58.01.02).

Surface water quality standards are divided into two broad categories based on the designated use: aquatic life and human health. The human health standards are further divided into consumption of water and organisms or the consumption of organisms only. The aquatic life standards are also divided, based on the duration of exposure, and include acute and chronic criteria. The Criteria Maximum Concentration (CMC) is the highest concentration to which aquatic life can be exposed for a 1-hour period without deleterious effects. The Criteria Continuous Concentration (CCC) is the highest concentration that aquatic life can be exposed to for an extended period. Of these standards, the aquatic life standards are generally the most rigorous.

Aquatic life standards are based on dissolved concentrations, with the exceptions of criteria for selenium, ammonia, and turbidity. The standard for selenium is based on total recoverable concentration. Standards for ammonia and turbidity are based on total concentration. The standard for ammonia depends on temperature and pH. Turbidity is measured in nephelometric turbidity units (NTU) and is not to exceed 50 NTU above background instantaneously or more than 25 NTU for more than 10 days. Cadmium, chromium (III), copper, lead, nickel, silver, and zinc standards are hardness-dependent and are calculated according to the following equations:

$$CMC = WER \cdot e^{m_A \cdot \ln(H) + b_A} \cdot K_A$$

$$CCC = WER \cdot e^{m_C \cdot \ln(H) + b_C} \cdot K_C$$

Where: WER is the water effect ratio
m_A is a metal-specific constant for acute toxicity
m_C is a metal-specific constant for chronic toxicity
H is hardness (mg/L as $CaCO_3$)
b_A is a metal-specific constant for acute toxicity
b_C is a metal-specific constant for chronic toxicity
K is a freshwater conversion factor (K_A = acute, K_C = chronic)

Aquatic life standards, based on 100 milligrams per liter (mg/L) hardness and a WER of 1, are presented in **Table 3.3-2**. Metal-specific constants and conversion factors for the calculation of hardness-specific standards are presented in **Table 3.3-3**.

In addition to the quality standards for surface water listed in **Table 3.3-2** and **Table 3.3-3**, Section 303(d) of the Clean Water Act (CWA) requires states to identify streams and lakes that do not meet water quality standards and to establish Total Maximum Daily Loads (TMDLs) for the listed pollutants. The listed 303 (d) water bodies and TMDLs near the analysis area are summarized in **Table 3.3-4** A map showing 303(d) listed water bodies near the analysis area is presented in **Figure 3.3-5**.

Table 3.3-2 Idaho Surface Water Quality Standards

	Surface Water Standards[1] (IDAPA 58.01.02)			
	Aquatic Life Based on 100 mg/L Total Hardness and WER[2] of 1		Standards for Human Health Based on Consumption of:	
Parameter (mg/L)	**CMC[3]**	**CCC[4]**	**Water and Organisms**	**Organisms Only**
Major Ions and Solution Parameters				
Chloride	—	—	—	—
Fluoride	—	—	—	—
Sulfate	—	—	—	—
TDS[5]	—	—	—	—
Nutrients				
Ammonia as Nitrogen	—[6]	—[7 or 8]	—	—
Nitrate as Nitrogen	—	—	—	—
Nitrite as Nitrogen	—	—	—	—
Metals				
Aluminum	—	—	—	—
Antimony	—	—	0.0056[9]	0.64[9]
Arsenic	0.340[10]	0.150[10]	0.010[11]	0.010[11]
Barium	—	—	—	—
Beryllium	—	—	—	—
Cadmium	0.0013[13]	0.0006[13]	—	—
Chromium	—	—	—	—
Chromium, VI	0.016[10]	0.011[10]	—	—
Chromium III	0.570[13]	0.074[13]	—	—
Copper	0.017[13]	0.011[13]	—	—
Iron	—	—	—	—
Lead	0.065[13]	0.0025[13]	—	—
Manganese	—	—	—	—
Mercury	—[12]	—[12]	—	—
Nickel	0.470[13]	0.0520[13]	0.610	4.6

Table 3.3-2 Idaho Surface Water Quality Standards

Parameter (mg/L)	Surface Water Standards[1] (IDAPA 58.01.02)			
	Aquatic Life Based on 100 mg/L Total Hardness and WER[2] of 1		Standards for Human Health Based on Consumption of:	
	CMC[3]	CCC[4]	Water and Organisms	Organisms Only
Selenium[8]	0.02	0.005	0.17	4.2
Silver	0.0034[13]	—	—	—
Thallium	—	—	0.00024[9]	0.00047[9]
Uranium	—	—	—	—
Zinc	0.120[13]	0.120[13]	7.4	26
Field Parameters				
pH (s.u.)	6.5-9.0			
Dissolved oxygen	>6 mg/L at all times			
Temperature (ºC)	<u><</u>22 ºC (daily average 19)			
Turbidity (NTU)	<u><</u>50 NTU above background (10 day consecutive <u><</u>25)			

Notes:

1 Water quality standards from Idaho Administrative Code April 1, 2014. Aquatic standards are based on dissolved concentrations with the exception of selenium, which is based on total recoverable concentration, and ammonia and turbidity, which are based on total concentration

2 WER is the water effect ratio

3 CMC is criterion maximum concentrations; acute

4 CCC is criterion continuous concentrations; chronic

5 TDS = total dissolved solids

6 Numeric criterion for ammonia CMC: the 1-hour average concentration of total ammonia nitrogen in mg N/L is not to exceed more than once every 3 years the value calculated by the following equation: $(0.275/(1+10^{7.204-pH}))+(39.0/(1+10^{pH-7.204}))$

7 Numeric criterion for ammonia CCC when fish early life stages are likely present: the 30-day average concentration of total ammonia nitrogen (mg N/L) is not to exceed more than once every 3 years the value calculated by the following equation: $(0.0577/(1+10^{7.688-pH}))+(2.487/(1+10^{pH-7.688}))*\min(2.85,1.45*(10^{0.028*(25-T)})$; T = °C, min represents the smallest number in a set of values

8 Numeric criterion for ammonia CCC when fish early life stages are likely absent is: the 30-day average concentration of total ammonia nitrogen (mg N/L) is not to exceed more than once every 3 years the value calculated by the following equation: $(0.0577/(1+10^{7.688-pH}))+(2.487/(1+10^{pH-7.688}))*(1.45*(10^{0.028*(25-T)})$; T =°C

9 Aquatic human health based standards for antimony and thallium, and aquatic standards for cold-water biota and human health, are fixed numerical standards

10 Standards for CMC and CCC are the presented values multiplied by the WER

11 Standards for human health apply to inorganic arsenic only

12 Fish tissue criteria per implementation guidance document for Idaho mercury water quality criteria (IDEQ 2005a)

13 Hardness-dependent CMC and CCC standards

Table 3.3-3 Metal-specific Constants and Conversion Factors for the Calculation of Cold-water Aquatic Life Water Quality Standards

Parameter	m_a[1]	b_a[2]	m_c[3]	b_c[4]	K_a[5]	K_c[6]
Arsenic	NA[7]	NA	NA	NA	1.0	1.0
Cadmium	0.8367	-3.560	0.6247	-3.344	0.944[8]	0.909[9]
Chromium (III)	0.819	3.7256	0.8190	0.6848	0.316	0.860
Chromium (VI)	NA	NA	NA	NA	0.982	0.962
Copper	0.9422	-1.464	0.8545	-1.465	0.960	0.960
Lead	1.273	-1.460	1.273	-4.705	0.791[10]	0.791[10]
Mercury	NA	NA	NA	NA	0.85	0.85
Nickel	0.846	2.255	0.8460	0.0584	0.998	0.997

Table 3.3-3 Metal-specific Constants and Conversion Factors for the Calculation of Cold-water Aquatic Life Water Quality Standards

Parameter	m_a[1]	b_a[2]	m_c[3]	b_c[4]	K_a[5]	K_c[6]
Silver	1.72	-6.52	—[11]	—[11]	0.85	—[11]
Zinc	0.8473	0.884	0.8473	0.884	0.978	0.986

Notes:
1 m_a = Metal-specific constant for acute toxicity
2 b_a = Metal-specific constant for acute toxicity
3 m_c = Metal-specific constant for chronic toxicity
4 b_c = Metal-specific constant for chronic toxicity
5 K_a = Acute freshwater conversion factor
6 K_c = Chronic freshwater conversion factor
7 NA = Not applicable
8 No acute conversion factor is required for cadmium. The cadmium acute criterion equation was derived from dissolved metals toxicity data. The equation Ka = 1.136672-[(ln hardness)(0.041838)] may be used to back-calculate an equivalent total recoverable concentration
9 Cadmium Kc = 1.101672-[(ln hardness)(0.041838)]
10 Lead Ka and Kc = 1.46203-[(ln hardness)(0.145712)]
11 No chronic standards have been established for silver

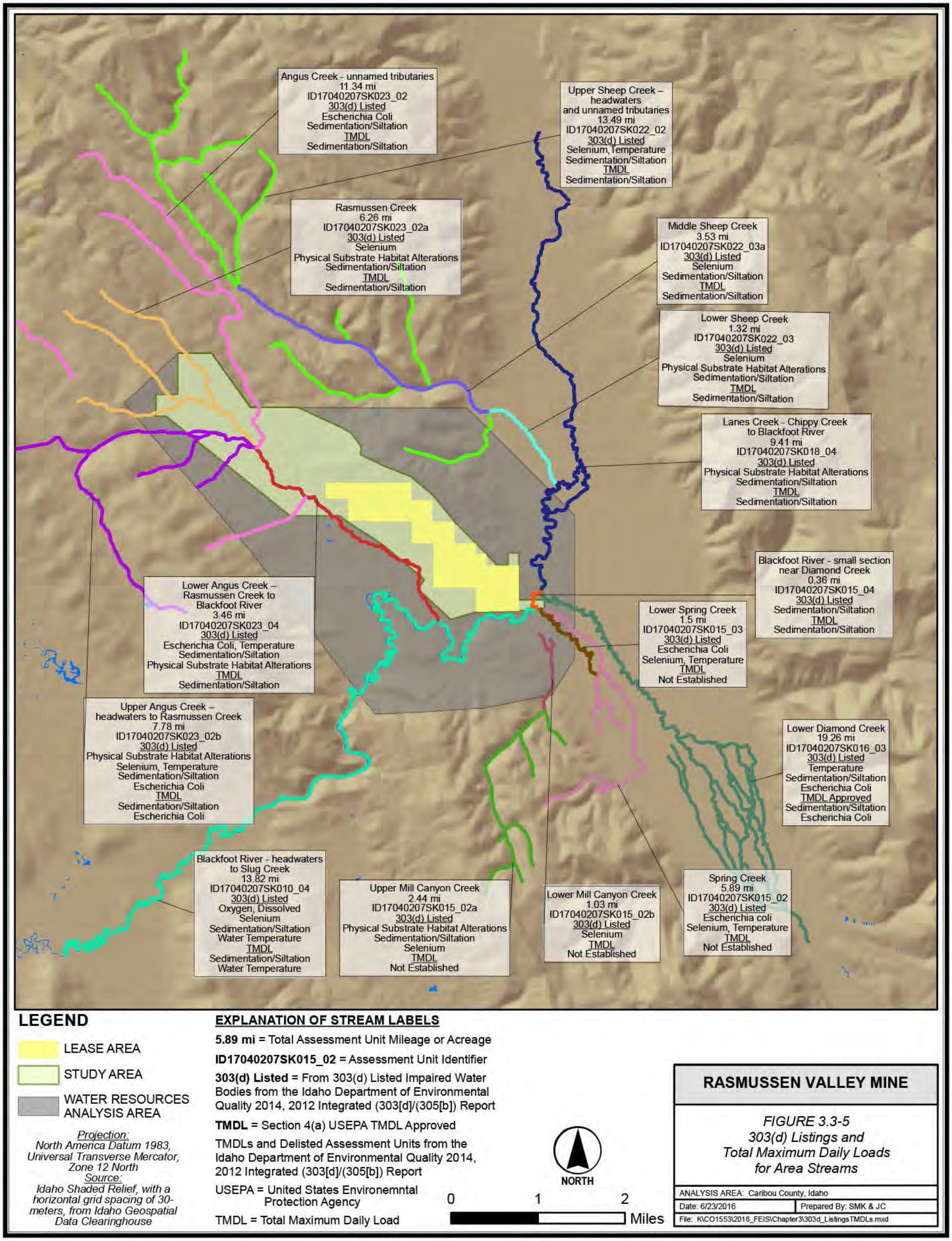
Table 3.3-4 303 (d) Listings and TMDLs for Water Bodies near the Analysis Area

Stream Segment	303 (d) Listings / TMDLs
Blackfoot River from confluence of Lanes and Diamond Creeks to Blackfoot Reservoir	Listed for sediment/siltation, dissolved oxygen, temperature, and selenium, with approved TMDLs for sediment and water temperature
Lanes Creek from Chippy Creek to Blackfoot River	Listed for sediment/siltation and physical substrate habitat alterations with an approved TMDL for sediment
Angus Creek from source to mouth	*Listed for Escherichia coli*, temperature, sediment/siltation, and physical substrate habitat alterations, with an approved TMDL for sediment
Upper Angus Creek	Listed for selenium with an approved TMDL for *Escherichia coli*
Lower Spring Creek	*Listed for Escherichia coli*, temperature, and selenium
Lower Diamond Creek	*Listed for Escherichia coli*, temperature, and sediment/siltation, with approved TMDLs for sediment and *Escherichia coli*
Rasmussen Creek	Listed for selenium, physical substrate habitat alterations, and sediment/siltation, with an approved TMDL for sediment

Source: IDEQ 2005a, 2014c

3.3.1.1.1 Blackfoot River

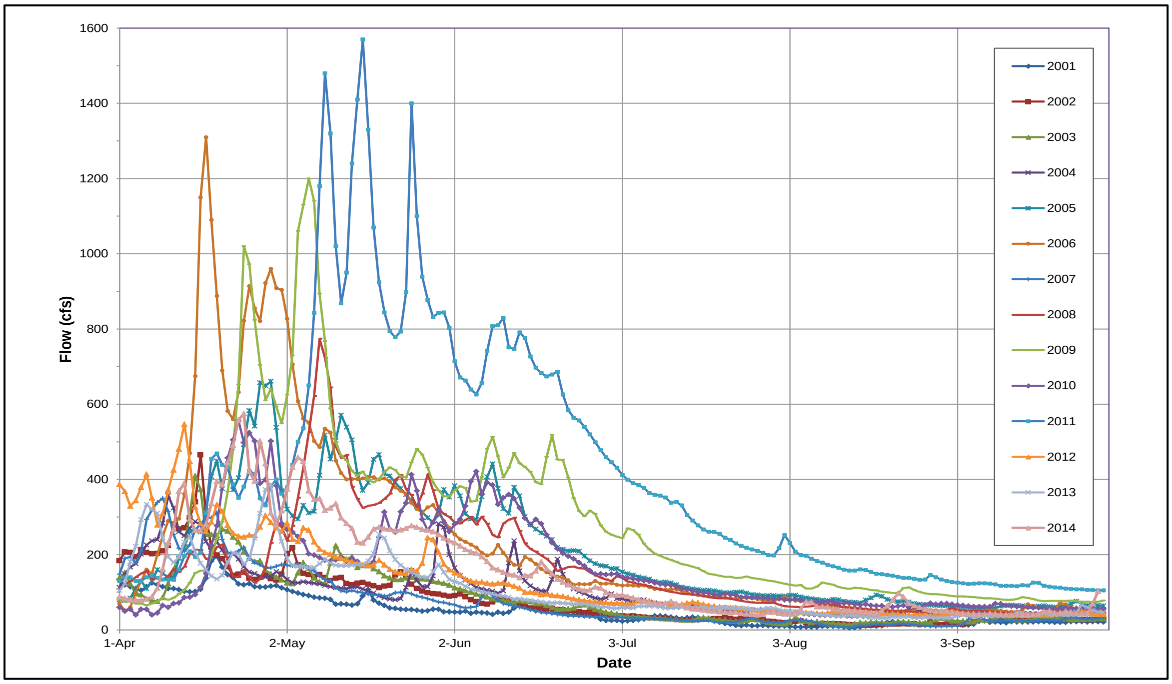
The Blackfoot River flows northwest from its headwaters near the Idaho-Wyoming state line to its confluence with the Snake River upstream of American Falls Reservoir. The Blackfoot River above Blackfoot Reservoir is generally a low-gradient river that meanders southwest from its origin and then northwest along alluvial valleys between northwest-trending ridges. Numerous small springs issue from the basalt outcrops along the channel of Blackfoot River where it passes through the Study Area. The Blackfoot River is designated for cold-water aquatic life, salmonid spawning, primary-contact recreation, and domestic water supply (IDAPA 58.01.02). It is a 303(d) listed stream for sediment/siltation, DO, temperature, and selenium, with approved TMDLs for sediment and water temperature from the confluence of Lanes and Diamond Creeks to Blackfoot Reservoir (**Figure 3.3-5**) (IDEQ 2005a, 2014c).


Angus Creek - unnamed tributaries
11.34 mi
ID17040207SK023_02
303(d) Listed
Escherichia Coli
Sedimentation/Siltation
TMDL
Sedimentation/Siltation
Upper Sheep Creek – headwaters and unnamed tributaries
13.49 mi
ID17040207SK022_02
303(d) Listed
Selenium, Temperature
Sedimentation/Siltation
TMDL
Sedimentation/Siltation
Rasmussen Creek
6.26 mi
ID17040207SK023_02a
303(d) Listed
Selenium
Physical Substrate Habitat Alterations
Sedimentation/Siltation
TMDL
Sedimentation/Siltation
Middle Sheep Creek
3.53 mi
ID17040207SK022_03a
303(d) Listed
Selenium
Sedimentation/Siltation
TMDL
Sedimentation/Siltation
Lower Sheep Creek
1.32 mi
ID17040207SK022_03
303(d) Listed
Selenium
Physical Substrate Habitat Alterations
Sedimentation/Siltation
TMDL
Sedimentation/Siltation
Lanes Creek - Chippy Creek to Blackfoot River
9.41 mi
ID17040207SK018_04
303(d) Listed
Physical Substrate Habitat Alterations
Sedimentation/Siltation
TMDL
Sedimentation/Siltation
Blackfoot River - small section near Diamond Creek
0.36 mi
ID17040207SK015_04
303(d) Listed
Sedimentation/Siltation
TMDL
Sedimentation/Siltation
Lower Angus Creek – Rasmussen Creek to Blackfoot River
3.46 mi
ID17040207SK023_04
303(d) Listed
Escherichia Coli, Temperature
Sedimentation/Siltation
Physical Substrate Habitat Alterations
TMDL
Sedimentation/Siltation
Lower Spring Creek
1.5 mi
ID17040207SK015_03
303(d) Listed
Escherichia Coli
Selenium, Temperature
TMDL
Not Established
Upper Angus Creek – headwaters to Rasmussen Creek
7.78 mi
ID17040207SK023_02b
303(d) Listed
Physical Substrate Habitat Alterations
Selenium, Temperature
Sedimentation/Siltation
Escherichia Coli
TMDL
Sedimentation/Siltation
Escherichia Coli
Lower Diamond Creek
19.26 mi
ID17040207SK016_03
303(d) Listed
Temperature
Sedimentation/Siltation
Escherichia Coli
TMDL Approved
Sedimentation/Siltation
Escherichia Coli
Blackfoot River - headwaters to Slug Creek
13.82 mi
ID17040207SK010_04
303(d) Listed
Oxygen, Dissolved
Selenium
Sedimentation/Siltation
Water Temperature
TMDL
Sedimentation/Siltation
Water Temperature
Upper Mill Canyon Creek
2.44 mi
ID17040207SK015_02a
303(d) Listed
Physical Substrate Habitat Alterations
Sedimentation/Siltation
Selenium
TMDL
Not Established
Lower Mill Canyon Creek
1.03 mi
ID17040207SK015_02b
303(d) Listed
Selenium
TMDL
Not Established
Spring Creek
5.89 mi
ID17040207SK015_02
303(d) Listed
Escherichia coli
Selenium, Temperature
TMDL
Not Established
LEGEND
LEASE AREA
STUDY AREA
WATER RESOURCES ANALYSIS AREA
Projection:
North America Datum 1983, Universal Transverse Mercator, Zone 12 North
Source:
Idaho Shaded Relief, with a horizontal grid spacing of 30-meters, from Idaho Geospatial Data Clearinghouse
EXPLANATION OF STREAM LABELS
5.89 mi = Total Assessment Unit Mileage or Acreage
ID17040207SK015_02 = Assessment Unit Identifier
303(d) Listed = From 303(d) Listed Impaired Water Bodies from the Idaho Department of Environmental Quality 2014, 2012 Integrated (303[d]/(305[b]) Report
TMDL = Section 4(a) USEPA TMDL Approved
TMDLs and Delisted Assessment Units from the Idaho Department of Environmental Quality 2014, 2012 Integrated (303[d]/(305[b]) Report
USEPA = United States Environemntal Protection Agency
TMDL = Total Maximum Daily Load
NORTH
0 1 2
Miles
RASMUSSEN VALLEY MINE
FIGURE 3.3-5
303(d) Listings and Total Maximum Daily Loads for Area Streams
ANALYSIS AREA: Caribou County, Idaho
Date: 6/23/2016
Prepared By: SMK & JC
File: K:\CO1553\2016_FEIS\Chapter3\303d_ListingsTMDLs.mxd

The Blackfoot River discharges into Blackfoot Reservoir 12.9 linear miles west of the Study Area. Blackfoot Reservoir was built in 1910 and is owned and operated by the Fort Hall Agency of the Bureau of Indian Affairs. Water stored in the reservoir is primarily used to irrigate lands on Fort Hall Indian Reservation near Blackfoot and Pocatello. Blackfoot Reservoir is a designated water body for cold-water aquatic life and primary-contact recreation (IDAPA 58.01.02).

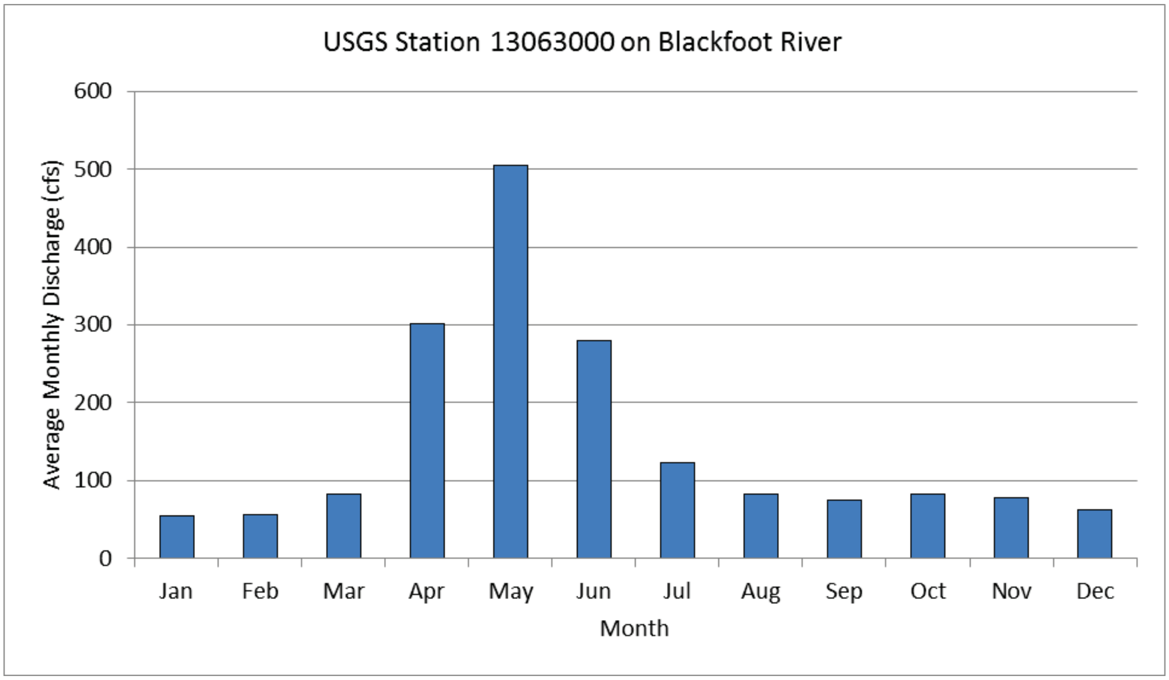
Streamflow data for the Blackfoot River are available from USGS monitoring station 13063000 and several monitoring stations within the Study Area that were established to complete gain-loss studies for the project (**Figure 3.3-4**). USGS monitoring station 13063000 is located 9.6 linear miles downstream of the Study Area, above Blackfoot Reservoir, and has operated intermittently from 1914 to present. Beginning in 2001, the station has operated seasonally April through October. Hydrographs for the Blackfoot Bridge monitoring station are presented on **Figure 3.3-6**.

Figure 3.3-6 Hydrograph Showing Peak Flows for Blackfoot River between 2001 and 2014



Streamflow in the Blackfoot River upstream of the Blackfoot Reservoir is regulated by snowmelt, precipitation, and groundwater discharge. Peak flows generally occur in April or May during spring runoff and decline to low-flow conditions by mid- to late summer. Average monthly discharge for Blackfoot River at the USGS monitoring station is highest in May (501 cubic feet per second [cfs]) followed by April (302 cfs) and June (276 cfs). The low-flow period for Blackfoot River typically extends from August through March, with monthly average discharge ranging from 54 to 82 cfs (**Figure 3.3-7**).

Figure 3.3-7 Average Monthly Stream Flow (1914 – 2014) for Blackfoot River at USGS Gaging Station 13063000



The Blackfoot River discharges into Blackfoot Reservoir 12.9 linear miles west of the Study Area. Blackfoot Reservoir was built in 1910 and is owned and operated by the Fort Hall Agency of the Bureau of Indian Affairs. Water stored in the reservoir is primarily used to irrigate lands on Fort Hall Indian Reservation near Blackfoot and Pocatello. Blackfoot Reservoir is a designated water body for cold-water aquatic life and primary-contact recreation (IDAPA 58.01.02).

Peak flows for the Blackfoot River have ranged from 221 to 1,570 cfs since 2001 (USGS 2014c; **Figure 3.3-6**). The highest recorded daily average streamflow at the USGS monitoring station was 2,150 cfs on April 26, 1974 (USGS 2014c).

Three monitoring stations were established on the Blackfoot River for the Baseline Water Resources Study: SW-BF1, SW-BF-2, and SW-BF3 (**Figure 3.3-4**). Station SW-BF1 is a dedicated stream gage that measures stream stage at 15-minute intervals. A hydrograph for the station is presented on **Figure 3.3-8**. The highest estimated flow at SW-BF1 was 2,312 cfs on May 16, 2011. Peak flows in subsequent years were estimated to range from 230 to 541 cfs (Whetstone 2015b). Precipitation at the Natural Resource Conservation Service SNOTEL monitoring station at Somsen Ranch in 2011 was 130 percent above average, which contributed to the high peak flow on the Blackfoot River that year. The Somsen Ranch monitoring station is located 7.9 miles north of the Proposed Action.

Two gain-loss studies were also completed on the Blackfoot River as part of the baseline analysis. The studies were performed at stations GLS-BF1 through GLS-BF5 (**Figure 3.3-4**) during the low-flow periods in August 2012 and September 2013 and were intended to evaluate the interaction between surface water and groundwater for the Blackfoot River. The recorded flows at station GLS-BF3 during the gain-loss studies ranged from 29.72 to 29.92 cfs (**Table 3.3-5**). The evaluated reaches are numbered sequentially, moving from upstream to downstream, and are shown on **Figure 3.3-4**. Data from the gain-loss studies indicate that BFR-Reach 1 is a losing segment under baseflow conditions. The results for BFR-Reach 2 through BFR-Reach 4 were indeterminate, indicating that the stream segments demonstrated gained or lost flow depending on the date of the survey. The ambiguity of the results for BFR-Reach 2 through BFR-Reach 4 is most likely related to the accuracy of the measurements, which are estimated to be plus or minus 10 to 20 percent of the total streamflow at any given station. The gain-loss data are not interpreted to indicate that the monitored reaches alternate between gaining and losing conditions during the low-flow period for the river. The measured gains and losses on Blackfoot River represent late summer and fall baseflow conditions, and may not be representative of gains or losses during spring runoff.

Table 3.3-5 Results of Gain-Loss Studies on Blackfoot River

Survey Date	Discharge at GLS-BF3 (cfs)	BFR -Reach 1 (cfs)	BFR -Reach 2 (cfs)	BFR -Reach 3 (cfs)	BFR -Reach 4 (cfs)
August 2012	29.72	-8.90	+5.86	-3.11	-0.94
September 2013	29.92	-3.49	-0.34	+1.60	+6.37

Note:
Positive values indicate gaining sections, negative values indicate losing sections

3.3.1.1.2 Lanes Creek

Lanes Creek is a perennial stream that originates 8.3 miles northeast of the Study Area near Stump Peak and flows northwest from its headwaters for 3.2 miles before turning west and then south through Upper Valley to its confluence with Diamond Creek. Lanes Creek receives flow from numerous tributaries that drain mountainous areas to the east and west of Upper Valley. Sheep Creek and Bacon Creek are named tributaries to Lanes Creek that occur near the Study Area. Lanes Creek is 303(d) listed for sediment/siltation and physical substrate habitat alterations with an approved TMDL for sediment from Chippy Creek to the Blackfoot River (**Figure 3.3-5**) (IDEQ 2005a, 2014c).

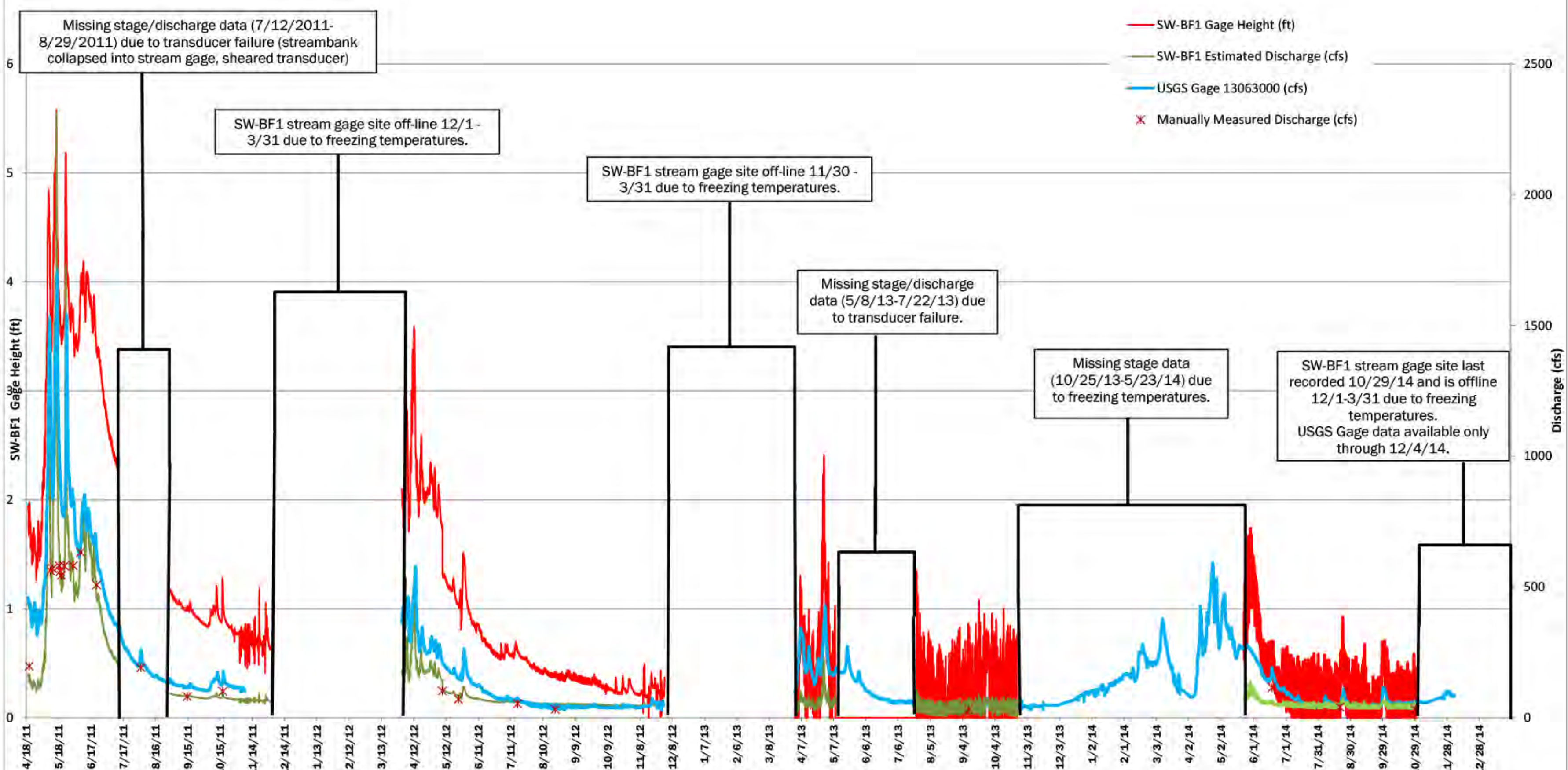
Two monitoring stations were established on Lanes Creek for the Baseline Water Resources Study: SW-LC1 and SW-LC2 (**Figure 3.3-4**). Streamflow and water quality were monitored at these stations. Streamflow in Lanes Creek was also monitored at station GLS-BF1 above its confluence with Diamond Creek on two dates in 2010 as part of the gain-loss studies for Blackfoot River. The measured flows during baseline monitoring ranged from 4 to 133 cfs (Whetstone 2015b).

3.3.1.1.3 Diamond Creek

Diamond Creek is a perennial stream with headwaters located in the valley between Dry Ridge and the Webster Range. Diamond Creek flows northwest from its origin to its confluence with Lanes Creek to form the headwater of the Blackfoot River. Lower Diamond Creek is a 303(d) listed stream for *Escherichia coli*, water temperature, and sediment/siltation, with approved TMDLs for sediment and *Escherichia coli* (**Figure 3.3-5**) (IDEQ 2005a, 2014c).

Streamflow and water quality data for Diamond Creek are available from baseline monitoring station SW-DC1, which is located immediately above the confluence with Lanes Creek (Figure 3.3-4). The measured flows during baseline monitoring have ranged from 8 to 99 cfs (Whetstone 2015b).

Figure 3.3-8 Hydrograph of Blackfoot River Discharge at Diamond Creek Bridge (Station SW-BF1) and Blackfoot Bridge (USGS Station 13063000)



Note: USGS Gage 13063000 data recorded in 15-minute intervals. This data was not available from 11/7/11-11/30/11, and the gage does not record 12/1 to 3/31. Source: http://waterdata.usgs.gov/nwis/uv?site_no=13063000

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3.3.1.1.4 Spring Creek

Spring Creek is a perennial stream tributary to the Blackfoot River 0.4 mile below the Blackfoot River headwater. Spring Creek flows northwest parallel to Diamond Creek, but is located within the Angus Creek-Blackfoot River Sub-Watershed. Spring Creek and lower Spring Creek are 303(d) listed for *Escherichia coli*, selenium, and water temperature (**Figure 3.3-5**) (IDEQ 2005a, 2014c). Spring Creek receives discharge from Mill Canyon Creek. Upper Mill Canyon Creek is a perennial stream that is 303(d) listed for physical substrate habitat alteration, sediment/siltation, and selenium. Lower Mill Canyon Creek is 303(d) listed for selenium.

Streamflow and water quality data for Spring Creek are available from baseline monitoring station SW-SPC1, which is located immediately above the confluence with Lanes Creek (**Figure 3.3-4**). The measured flows during baseline monitoring have ranged from 7 to 107 cfs (Whetstone 2015b).

3.3.1.1.5 Angus Creek

Angus Creek drains Rasmussen Valley west of the Study Area (**Figure 3.3-2**). It flows northwest from its source in Little Long Valley (a small valley in the south-central portion of Wooly Range), curves east, and then flows 600 feet downstream from the project boundary. Upper Angus Creek, from its headwater to Rasmussen Creek, is 303(d) listed for sediment/siltation, water temperature, *Escherichia coli*, physical substrate habitat alterations, and selenium. It has approved TMDLs for sedimentation/siltation and *Escherichia coli*. Lower Angus Creek from Rasmussen Creek to the Blackfoot River is 303(d) listed for sediment/siltation, water temperature, physical substrate habitat alterations, and *Escherichia coli* with an approved TMDL for sedimentation/siltation. Unnamed tributaries to Angus Creek are also 303(d) listed for sedimentation/siltation and *Escherichia coli* with approved TMDL for sedimentation/siltation (**Figure 3.3-5**) (IDEQ 2005a, 2014c).

Three monitoring stations were established on Angus Creek for the Baseline Water Resources Study: SW-AC1, SW-AC2, and SW-AC3 (**Figure 3.3-4**). The stations were used to monitor streamflow and water quality. Measured flows during baseline monitoring ranged from 0.004 cfs to 53 cfs (Whetstone 2015b). Four gain-loss studies were also completed on Angus Creek for the baseline analysis. The studies were performed for two reaches between stations GLS-AC1, GLS-AC2, and GLS-AC3 (**Figure 3.3-4**) during the low-flow periods between August 2010 and September 2013. The gain-loss measurements indicated that Angus Creek is a losing stream below station GLS-AC3 during low-flow conditions (**Table 3.3-6**). The measured gains and losses on Angus Creek represent late summer and fall baseflow conditions, and may not be representative of conditions during spring or early summer.

Table 3.3-6 Results of Gain-Loss Studies on Angus Creek

Survey Date	Discharge at GLS-AC1 (cfs)	AC -Reach 1 (cfs)	AC -Reach 2 (cfs)
August 2010	1.96	-0.69	-0.40
October 2010	0.86	-0.01	-0.06
August 2011	1.93	+0.01	-0.02
August 2012	0.19	-0.08	-0.00
September 2013	0.52	-0.25	-0.09

Note:
Positive values indicate gaining sections, negative values indicate losing sections

3.3.1.1.6 Rasmussen Creek

Rasmussen Creek is tributary to Angus Creek and originates northwest of the Study Area at the divide between Rasmussen Valley and Enoch Valley. Its headwaters are located within the disturbance area of the North Rasmussen Ridge Mine. Rasmussen Creek is 303(d) listed for sedimentation/siltation, selenium, and physical substrate habitat alterations with an approved TMDL for sedimentation/siltation (**Figure 3.3-5**; IDEQ 2005a, 2014c).

Two monitoring stations were established on Rasmussen Creek for the Baseline Water Resources Study: SW-RC1 and SW-RC2 (**Figure 3.3-4**). Measured flows during baseline monitoring ranged from 0.08 to 4 cfs (Whetstone 2015b).

3.3.1.1.7 Unnamed Tributary to Lanes Creek Water Quality

Baseline monitoring station SW-UN1 (**Figure 3.3-4**) is located on an unnamed tributary to Lanes Creek that drains a reclaimed surface disturbance area at the Lanes Creek Mine. The station is used to monitor stream flow and water quality annually. The unnamed tributary has perennial flow in an incised low-gradient meandering channel. Measured flows at SW-UN1 ranged from 0.2 to 4 cfs during baseline monitoring (Whetstone 2015b).

3.3.1.1.8 Intermittent Tributaries

Sixteen baseline monitoring stations were established in intermittent drainages in the Study Area (**Figure 3.3-4**). Most of the drainages are tributary to Angus Creek and occur on the southwest slope of Rasmussen Ridge. The drainages flow seasonally in response to snowmelt and precipitation. Intermittent streams are defined as streams that have no surface flow for at least 1 week during most years (IDAPA 58.01.02). Numerical water quality standards only apply to intermittent waters during periods of optimum flow that are sufficient to support the uses for which the water body is designated. Optimum flow for recreation is defined as being greater than or equal to 5 cfs. Optimum flow for aquatic life is greater than or equal to 1 cfs (IDAPA 58.01.02).

3.3.1.1.9 Springs and Seeps

A total of 14 seeps, springs, and spring complexes were identified in the Study Area during baseline surveys (**Figure 3.3-4**; Whetstone 2015b). Most of the springs occur west of the Study Area in Rasmussen Valley or are located along the banks of Blackfoot River. The springs and seeps are intermittent and flow seasonally with the exceptions of SW-SPRING1 and SW-SPRING3. Spring SW-SPRING1 is perennial and issues from an unnamed drainage in Upper Valley east of the Study Area. The observed flows from the spring have ranged from less than 0.02 to 2 cfs. Spring SW-SPRING3 is perennial and issues from the bank of the Blackfoot River southwest of the Study Area. The observed flows from the spring have ranged from damp with no flow to 0.034 cfs. Springs and seeps identified during the baseline surveys were monitored for flow and water quality (Whetstone 2015b).

3.3.1.2 Chemical Characteristics of Surface Water

3.3.1.2.1 Selenium in the Upper Blackfoot River Watershed

The upper Blackfoot River watershed includes 12 phosphate mining areas, three of which are currently active. Phosphate mine overburden contains selenium, which can be transported into streams by runoff or seepage depending on site-specific conditions. The USGS, in cooperation with BLM, has monitored selenium concentrations in Blackfoot River at station 13063000 since 2001. The station typically operates from April through October of each year and uses an automatic sampler to collect water quality samples based on the stage (height) of the river. Synoptic sampling (i.e., samples collected during a short period of time) at 21 sites on the

Blackfoot River and its tributaries above USGS station 13063000 has also been performed by IDEQ during May of each year since 2001 (Mebane et al. 2015).

Dissolved selenium concentrations in 450 samples collected at USGS station 13063000 between 2001 and 2012 ranged from 0.0005 to 0.0114 mg/L. The State of Idaho CCC of 0.005 mg/L was exceeded in 31 percent of the samples, with 80 percent of the exceedances occurring during May, and 17 and 3 percent of the exceedances occurring during April and June, respectively. No exceedances of the selenium criterion were recorded in months other than April, May, or June. Speciation data from the USGS station indicate that selenate is the dominant form of selenium in surface water (81 percent median value), followed by selenite (19 percent median value), and organic selenium (trace). Dissolved selenium typically accounts for more than 90 percent of the total selenium in the water column (Presser et al. 2004). Selenium concentrations in the Blackfoot River have indicated an increasing upward trend during the low-flow period between August and October during 2001 through 2012, but trends are not obvious for other seasons (Mebane et al. 2015). Trends in selenium during the low-flow period in 2013 and 2014 (additional data from USGS station 1306300 not tracked in Mebane et al. 2015) may indicate a flatter trend than previously reported.

Synoptic sampling by IDEQ during the month of May between 2001 and 2012 indicates that the majority of the selenium load passing the USGS station originates from a single tributary, Mill Canyon Creek (also referred to as East Mill Creek), which enters the Blackfoot River through Spring Creek in the Study Area. Selenium loads in Mill Canyon Creek decrease by about half before reaching the Blackfoot River, suggesting that much of the selenium is at least temporarily removed from the water column through uptake by aquatic vegetation or through losses to sediment. Similar decreases in selenium loads occurred in the main stem Blackfoot River above the USGS station in low-flow years, but not in high-flow years (Mebane et al. 2015).

Selenium concentrations in the upper Blackfoot River watershed tend to correlate positively with streamflow (i.e., high concentrations are typically observed in years with high streamflows). Water years 2006 through 2008 were exceptions to this generalization, which suggests that streamflow is not the only factor controlling selenium concentrations in the river (Mebane et al. 2015). The relationship between streamflow and selenium concentration is also affected by annual patterns of streamflow that tend to have more than one peak. Peak selenium concentrations at the USGS monitoring station have lagged from 2 to 36 days behind peak streamflows for the period of record with a median lag of 14 days. The lag between peak streamflows and peak selenium concentrations was shorter during high-flow years.

3.3.1.2.2 Blackfoot River Water Quality

Baseline monitoring studies completed between April 1, 2010 and December 31, 2014 in the analysis area indicate that water in the Blackfoot River is a well buffered calcium-bicarbonate type water with low to moderate concentrations of total dissolved solids (TDS; 122 to 230 mg/L) and circum-neutral to moderately alkaline pH (6.28 to 8.82 standard units [s.u.]). Water in the river did not meet Idaho Cold-water Aquatic Life Standards for pH (6.5 to 9.0 s.u.) in two of 96 samples collected during baseline monitoring, but generally met all other applicable water quality standards with the exception of total selenium. Total selenium concentrations were equal to or exceeded the Cold-water Aquatic Life CCC of 0.005 mg/L at least four times at all stations (13 of 48 samples). The observed range of total selenium concentrations was 0.00089 to 0.011 mg/L, with the highest concentrations occurring during the spring high-flow period (**Figure 3.3-9**).

Data from USGS monitoring station 13063000 indicate that selenium concentrations in the Blackfoot River are cyclic and generally exceed the CCC of 0.005 mg/L each spring during the peak flow period (**Figure 3.3-10**). This seasonal cycling is likely related to increased seepage and runoff from phosphate mine disturbance areas in the Blackfoot Sub-Basin during spring snowmelt (Whetstone 2009). The USGS station also reported cadmium concentrations that exceeded the CCC of 0.0006 mg/L on three dates during the spring of 2006 and 2007. The elevated cadmium concentrations ranged from 0.00062 to 0.00104 mg/L. Cadmium was not detected during baseline surface water monitoring for Blackfoot River.

Figure 3.3-9 Selenium Concentrations and Discharge for Baseline Monitoring Stations on Blackfoot River

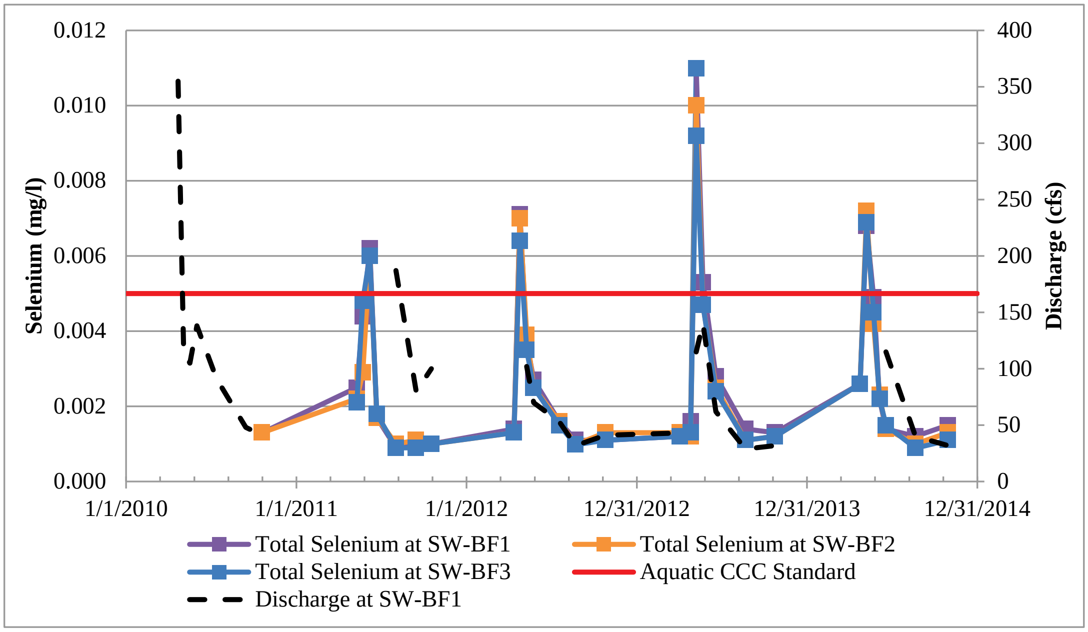
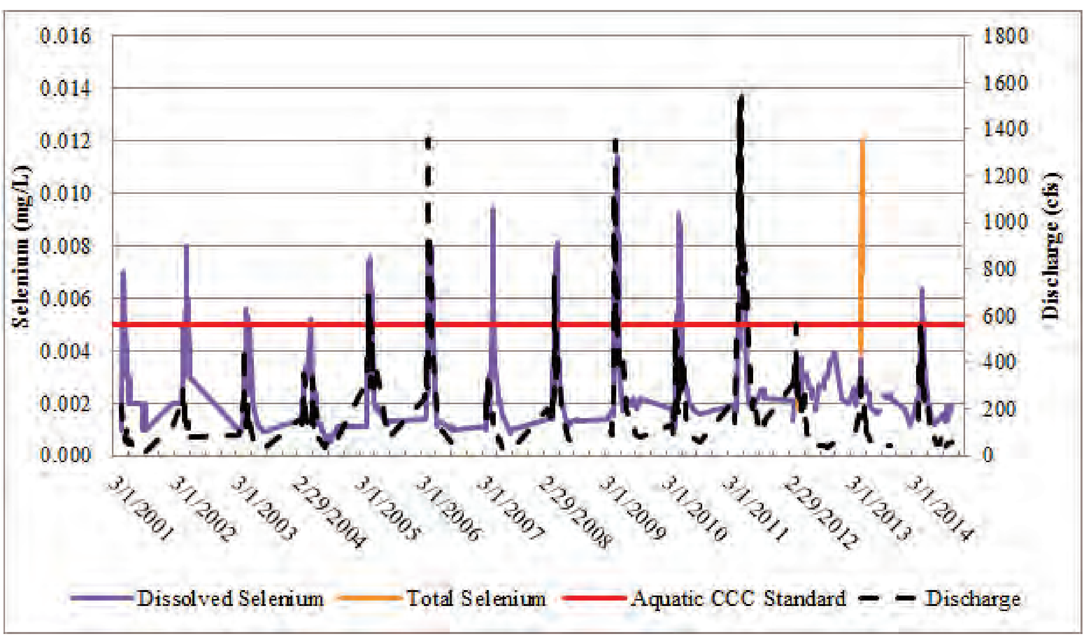


Figure 3.3-10 Selenium Concentrations and Discharge for USGS Monitoring Station 13063000 on Blackfoot River

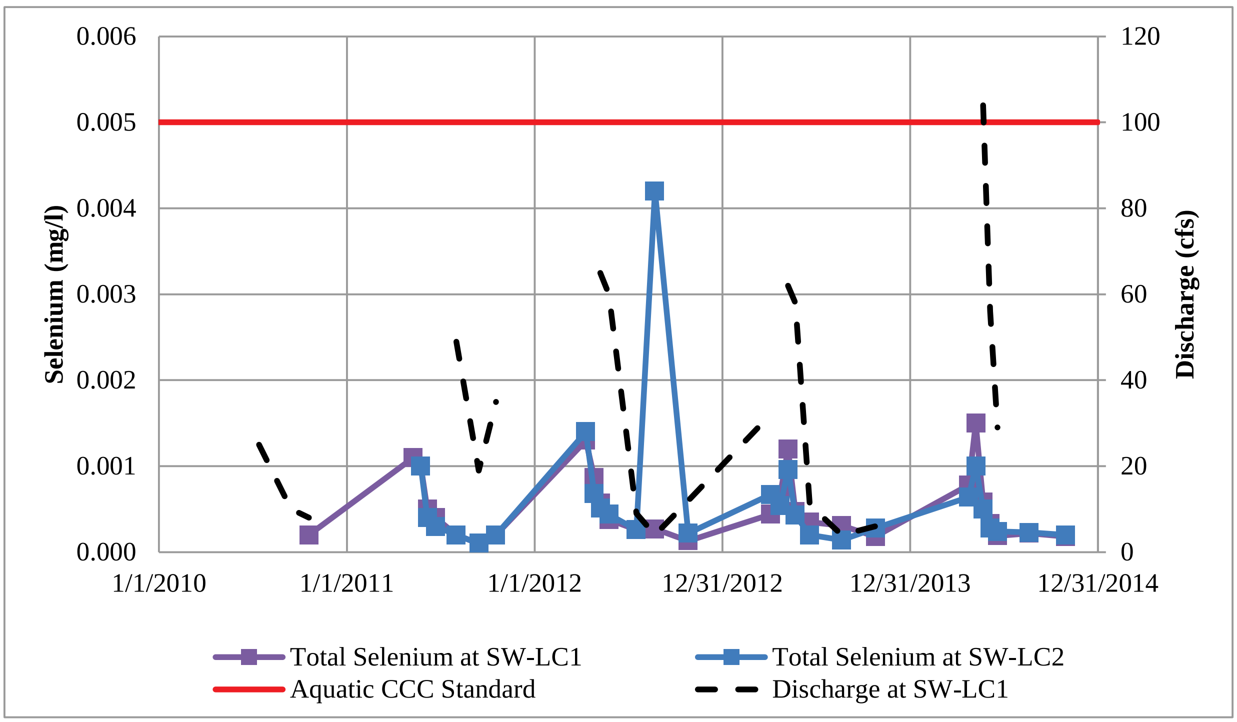


Water quality data for the Blackfoot River above Blackfoot Reservoir are also available from monitoring completed for the TMDL study (Tetra Tech 2002a, 2002b, 2004; IDEQ 2005b, 2005c, 2006, 2007). Reported selenium concentrations of Blackfoot River water from these studies ranged from 0.0001 to 0.012 mg/L. Cadmium concentrations in the river were generally below detection limits, with the exception of one sample that yielded a concentration of 0.0000667 mg/L.

3.3.1.2.3 Lanes Creek Water Quality

Water in Lanes Creek is a well buffered calcium-bicarbonate type water with low to moderate concentrations of TDS (88 to 238 mg/L) and circum-neutral to moderately alkaline pH (7.01 to 8.92 s.u.). Selenium was present at detectable concentrations in most water samples from Lanes Creek. The observed range of total selenium concentrations was less than 0.0001 mg/L to 0.0042 mg/L (**Figure 3.3-11**). Selenium concentrations in Lanes Creek exhibit a pattern of seasonal cycling similar to that of the Blackfoot River.

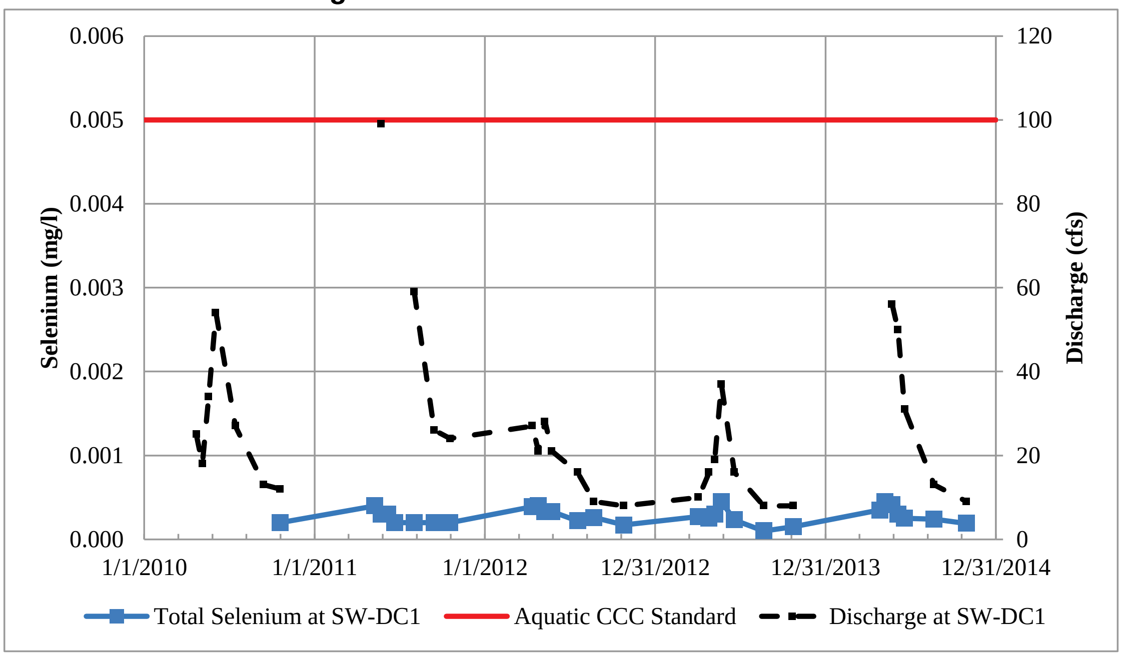
Figure 3.3-11 Selenium Concentrations and Discharge for Baseline Monitoring Stations on Lanes Creek



3.3.1.2.4 Diamond Creek Water Quality

Water in Diamond Creek is a well buffered calcium-bicarbonate type water with low to moderate concentrations of TDS (154 to 210 mg/L) and circum-neutral to alkaline pH (6.37 to 9.24 s.u.). Water in the creek did not meet the Idaho Cold-water Aquatic Life Standard (6.5 to 9.0 s.u.) for pH during one sampling event, but met all other applicable surface water quality standards during baseline monitoring. Selenium was present at detectable concentrations in most water samples from Diamond Creek. The observed range of total selenium concentrations was less than 0.0001 mg/L to 0.00045 mg/L (**Figure 3.3-12**). Selenium concentrations in Diamond Creek exhibit a subdued pattern of seasonal cycling similar to that of the Blackfoot River.

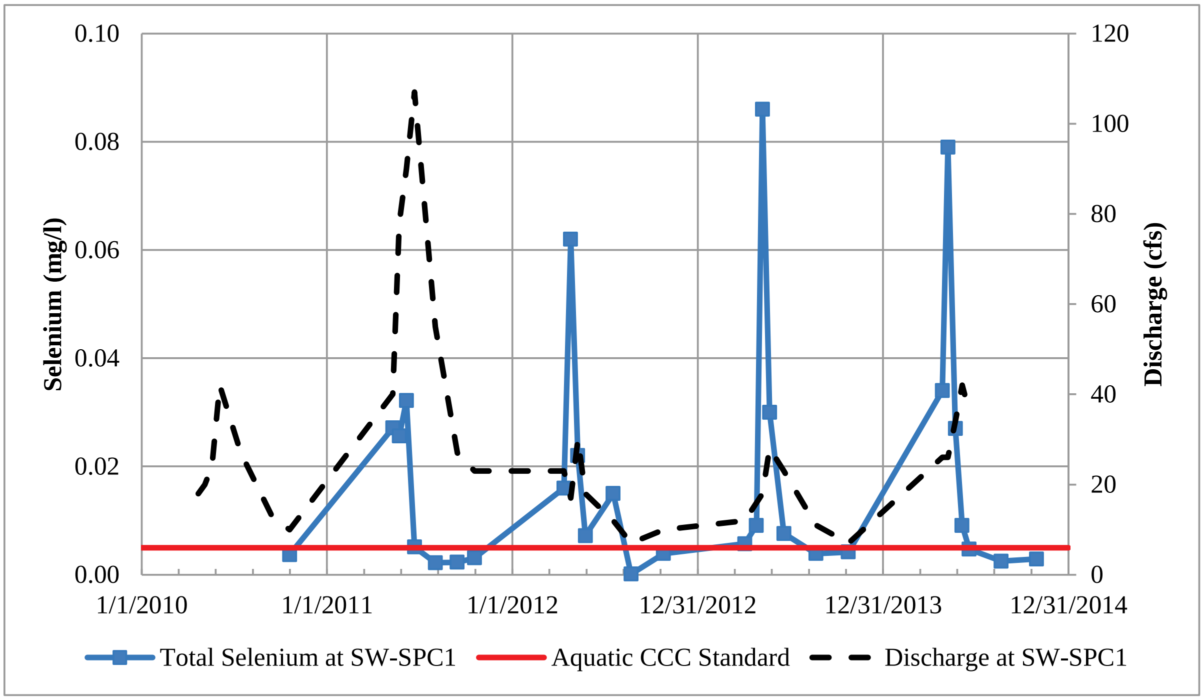
Figure 3.3-12 Total Selenium Concentrations and Discharge, Diamond Creek Baseline Monitoring 2010 to 2014



3.3.1.2.5 Spring Creek Water Quality

Water in Spring Creek is a well buffered calcium-bicarbonate type water with low to moderate concentrations of TDS (180 to 264 mg/L) and circum-neutral to moderately alkaline pH (7.02 to 8.86 s.u.). Water in the creek did not meet the CCC Idaho Cold-water Aquatic Life Standard for total selenium (0.005 mg/L) in 17 of 28 samples, and was detected in 96 percent of the samples collected during the baseline monitoring period. The observed range of total selenium concentrations was less than 0.0001 mg/L to 0.086 mg/L (**Figure 3.3-13**). Selenium concentrations in Spring Creek originate from previous phosphate mining operations in the Mill Creek drainage, which is tributary to Spring Creek and have a pattern of seasonal cycling similar to that of the Blackfoot River.

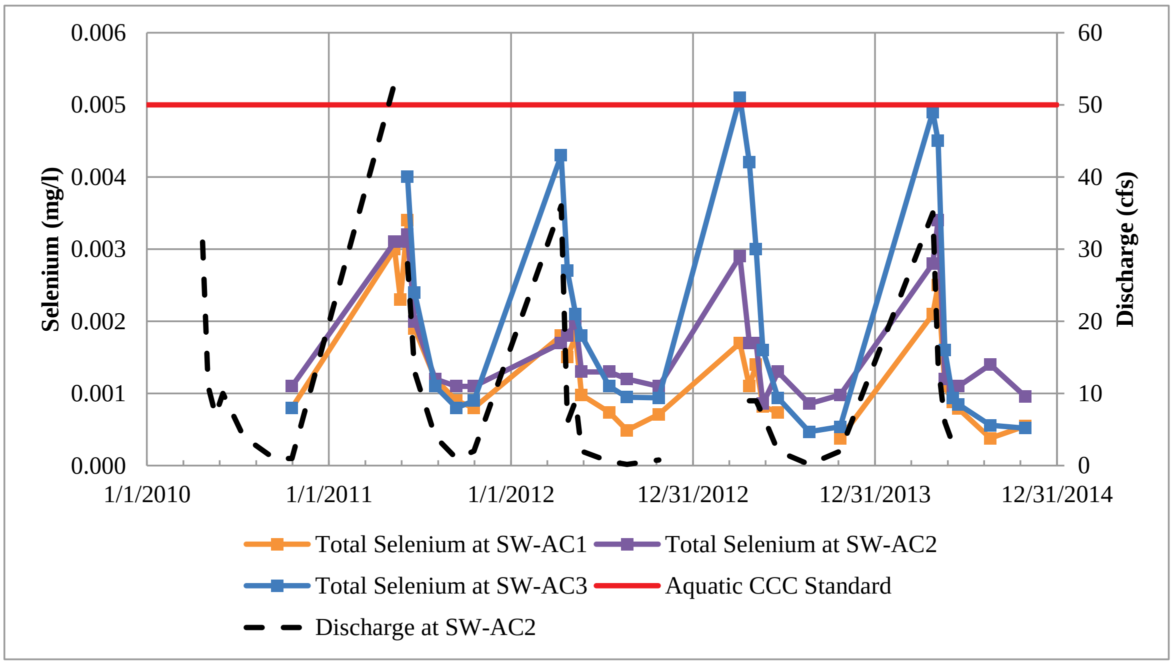
Figure 3.3-13 Selenium Concentrations and Discharge for Baseline Monitoring Stations on Spring Creek



3.3.1.2.6 Angus Creek Water Quality

Baseline monitoring indicates that water in Angus Creek is a well buffered calcium-bicarbonate type water with low to moderate concentrations of TDS (100 to 310 mg/L) and circum-neutral to moderately alkaline pH (6.14 to 8.47 s.u.). Water in Angus Creek met the Idaho Cold-water Aquatic Life Standard for pH (6.5 to 9.0 s.u.) at all stations during the baseline monitoring period with the exception of one sample from SW-AC2 on May 24, 2011 that exhibited a pH of 6.14 s.u. Selenium concentrations in Angus Creek were generally below the CCC with the exception of one sample (**Figure 3.3-14**). The observed range of total selenium concentrations in Angus Creek was less than 0.00038 mg/L to 0.0051 mg/L. Selenium concentrations in Angus Creek exhibit a pattern of seasonal cycling similar to that of the Blackfoot River. All other analyses for samples collected from Angus Creek met applicable surface water standards.

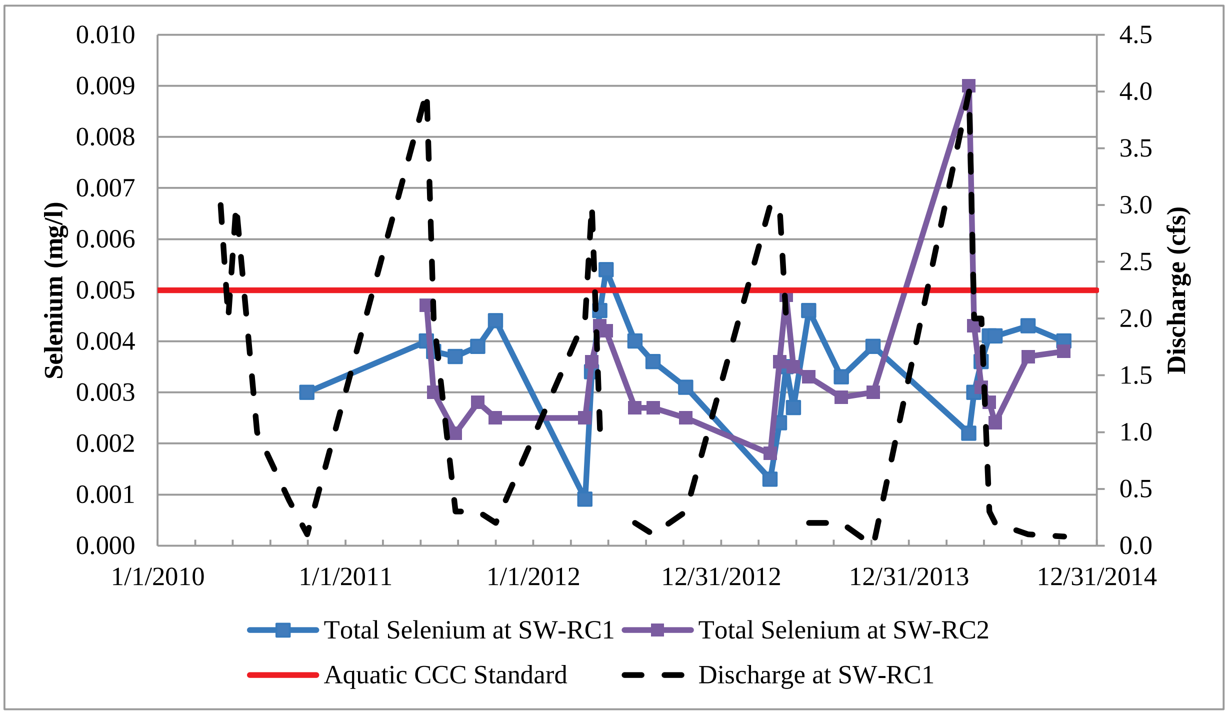
Figure 3.3-14 Selenium Concentrations and Discharge for Baseline Monitoring Stations on Angus Creek



3.3.1.2.7 Rasmussen Creek Water Quality

Baseline monitoring indicates that water in Rasmussen Creek is a moderately buffered, calcium-bicarbonate to calcium-sulfate type water with low to moderate concentrations of TDS (97 to 338 mg/L) and circum-neutral to moderately alkaline pH (6.24 to 8.67 s.u.). Water in Rasmussen Creek generally met the applicable Idaho Cold-water Aquatic Life Standard for pH (6.5 to 9.0 s.u.) with the exception of the June sampling event in 2013 when the measured value was 6.24 s.u. Selenium (0.0054 mg/L), and thallium (0.0003 mg/L) exceeded their applicable standards (the selenium CCC is 0.005 mg/L, the thallium aquatic standard for human health, water, and organisms is 0.00024 mg/L) at SW-RC1 on one date each during the baseline monitoring period. Selenium concentrations in Rasmussen Creek exhibit a pattern of seasonal cycling similar to that of the Blackfoot River (**Figure 3.3-15**), but peak concentrations do not correspond as closely to the peak flows.

Figure 3.3-15 Selenium Concentrations and Discharge for Baseline Monitoring Stations on Rasmussen Creek



3.3.1.2.8 Unnamed Tributary to Lanes Creek Water Quality

Baseline monitoring indicates that the unnamed tributary to Lanes Creek at station SW-UN1 contains well buffered calcium-bicarbonate type water with low concentrations of TDS (100 to 214 mg/L) and pH between 7.25 and 8.88. Water quality in the unnamed tributary met all applicable water quality standards during baseline monitoring events.

3.3.1.2.9 Intermittent Stream Water Quality

Baseline monitoring of 16 stations located on intermittent streams in the Study Area indicates that water quality in the drainages usually meets applicable water quality standards for all parameters, with sporadic exceptions for pH, arsenic, cadmium, copper, lead, and selenium. Summaries of baseline monitoring results that are equal to or exceed their applicable standards are presented in **Table 3.3-7** and **Table 3.3-8**.

3.3.1.2.10 Spring Water Quality

Baseline monitoring indicates that the water quality of seeps and springs in the Study Area usually meets potentially applicable water quality standards, with sporadic exceptions for pH, lead, selenium, thallium, and zinc. Summaries of baseline monitoring results that are equal to or exceed their applicable standards are presented in **Table 3.3-9** and **Table 3.3-10**.

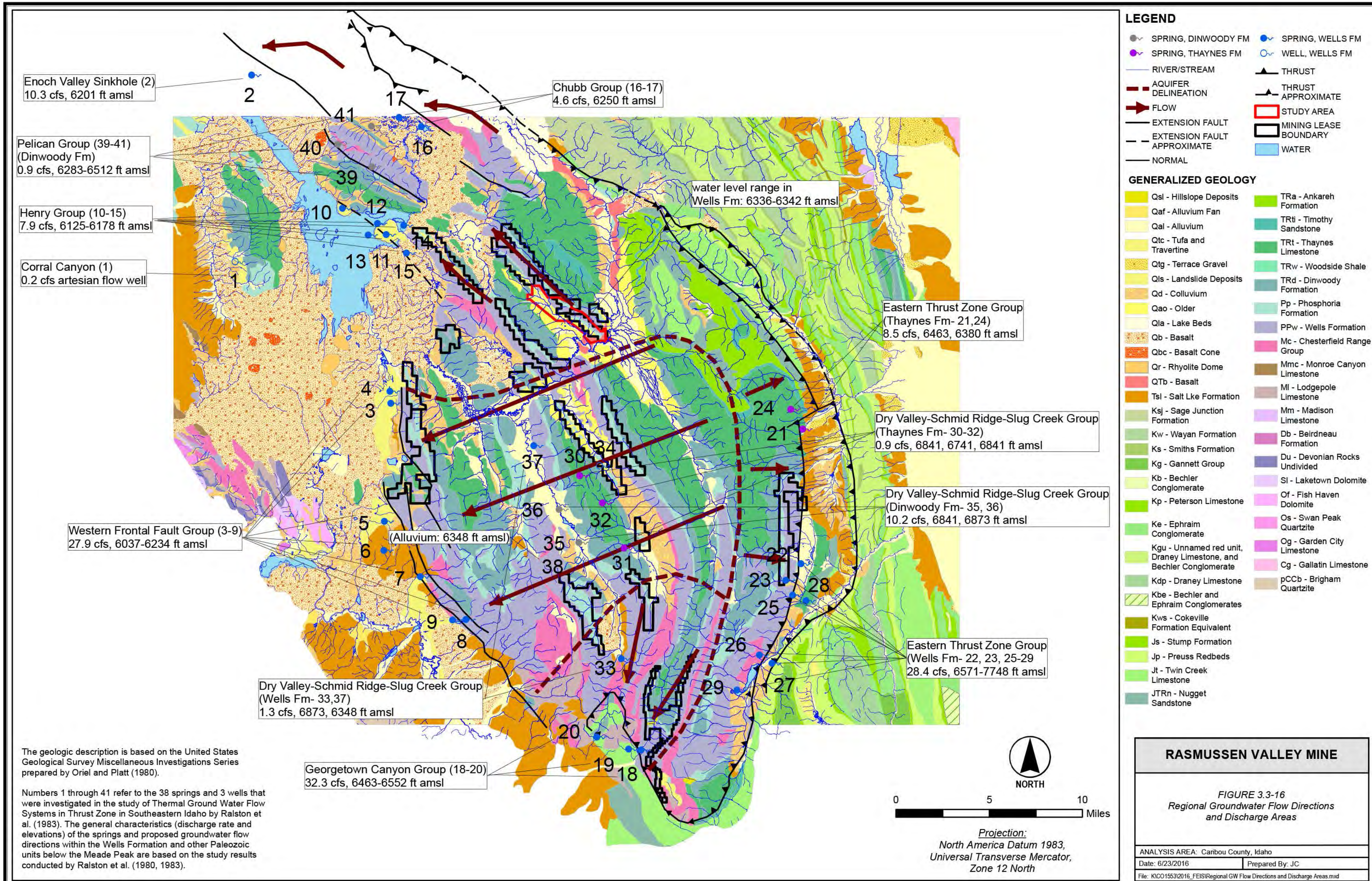
3.3.2 Groundwater Resources

3.3.2.1 Hydrogeologic Setting

Patterns of groundwater movement in the Southeast Idaho Phosphate District are controlled by flow from areas of recharge at higher elevations to areas of discharge at lower elevations. This flow occurs in local-, intermediate-, and regional-scale systems defined by topography, geology, and the continuity of the water-bearing units. With the exceptions of basalt, and the Meade Peak and Cherty Shale Members of the Phosphoria Formation, all geologic units at Rasmussen Valley are aquifers that host groundwater flow systems. Aquifers are defined as porous and permeable geologic strata that transmit groundwater in economically usable quantities. The Meade Peak and Cherty Shale Members typically have low permeability, and are considered to be aquitards (leaky barriers to groundwater flow) except where faulted or fractured (Ralston et al. 1977; Winter 1980). Basalt is unsaturated where it was encountered during drilling of monitoring wells within the Study Area.

3.3.2.1.1 Regional-scale Groundwater Flow System in the Grandeur Tongue and Wells Formation

The Grandeur Tongue and Wells Formation form a regionally extensive aquifer (Wells Regional Aquifer) that participates in inter-basin transfers of groundwater (Ralston et al. 1977, 1983; Winter 1980). Regional aquifers are characterized by long flow paths, inter-basinal flow, and large springs with nearly constant annual discharges. They contain large quantities of groundwater and are typically hosted by thick, aerially extensive formations that have relatively high permeability. Groundwater in the Wells Regional Aquifer may be confined or unconfined depending on location. The aquifer is typically confined where capped by the Meade Peak aquitard and unconfined in areas of surface outcrop. A confined aquifer has a water level that will rise above the top of the aquifer where tapped by a well. An unconfined aquifer is characterized by a water level that is below the top of the aquifer and is open to the atmosphere through the overlying permeable material. As shown on **Figure 3.3-16**, groundwater flow in the Wells Regional Aquifer near the Study Area is generally northwest from recharge areas along the ridge of the Snowdrift Anticline toward discharge areas at the Enoch Valley Sinkhole (Arcadis 2013; Ralston et al. 1983). The Enoch Valley Sinkhole is situated on the trace of the Enoch Valley Fault, but there are other high-discharge springs northwest of the Study Area, including the Henry spring complex, that are also potential discharge areas for the site.



Enoch Valley Sinkhole (2)
10.3 cfs, 6201 ft amsl
Chubb Group (16-17)
4.6 cfs, 6250 ft amsl
Pelican Group (39-41)
(Dinwoody Fm)
0.9 cfs, 6283-6512 ft amsl
Henry Group (10-15)
7.9 cfs, 6125-6178 ft amsl
Corral Canyon (1)
0.2 cfs artesian flow well
water level range in
Wells Fm: 6336-6342 ft amsl
Eastern Thrust Zone Group
(Thaynes Fm- 21,24)
8.5 cfs, 6463, 6380 ft amsl
Dry Valley-Schmid Ridge-Slug Creek Group
(Thaynes Fm- 30-32)
0.9 cfs, 6841, 6741, 6841 ft amsl
Dry Valley-Schmid Ridge-Slug Creek Group
(Dinwoody Fm- 35, 36)
10.2 cfs, 6841, 6873 ft amsl
Western Frontal Fault Group (3-9)
27.9 cfs, 6037-6234 ft amsl
(Alluvium: 6348 ft amsl)
Eastern Thrust Zone Group
(Wells Fm- 22, 23, 25-29
28.4 cfs, 6571-7748 ft amsl
Dry Valley-Schmid Ridge-Slug Creek Group
(Wells Fm- 33,37)
1.3 cfs, 6873, 6348 ft amsl
Georgetown Canyon Group (18-20)
32.3 cfs, 6463-6552 ft amsl
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41
The geologic description is based on the United States Geological Survey Miscellaneous Investigations Series prepared by Oriel and Platt (1980).
Numbers 1 through 41 refer to the 38 springs and 3 wells that were investigated in the study of Thermal Ground Water Flow Systems in Thrust Zone in Southeastern Idaho by Ralston et al. (1983). The general characteristics (discharge rate and elevations) of the springs and proposed groundwater flow directions within the Wells Formation and other Paleozoic units below the Meade Peak are based on the study results conducted by Ralston et al. (1980, 1983).
NORTH
0 5 10 Miles
Projection:
North America Datum 1983,
Universal Transverse Mercator,
Zone 12 North
LEGEND
SPRING, DINWOODY FM
SPRING, THAYNES FM
RIVER/STREAM
AQUIFER DELINEATION
FLOW
EXTENSION FAULT
EXTENSION FAULT APPROXIMATE
NORMAL
SPRING, WELLS FM
WELL, WELLS FM
THRUST
THRUST APPROXIMATE
STUDY AREA
MINING LEASE BOUNDARY
WATER
GENERALIZED GEOLOGY
Qsl - Hillslope Deposits
Qaf - Alluvium Fan
Qal - Alluvium
Qtc - Tufa and Travertine
Qtg - Terrace Gravel
Qls - Landslide Deposits
Qd - Colluvium
Qao - Older
Qla - Lake Beds
Qb - Basalt
Qbc - Basalt Cone
Qr - Rhyolite Dome
QTb - Basalt
Tsl - Salt Lke Formation
Ksj - Sage Junction Formation
Kw - Wayan Formation
Ks - Smiths Formation
Kg - Gannett Group
Kb - Bechler Conglomerate
Kp - Peterson Limestone
Ke - Ephraim Conglomerate
Kgu - Unnamed red unit, Draney Limestone, and Bechler Conglomerate
Kdp - Draney Limestone
Kbe - Bechler and Ephraim Conglomerates
Kws - Cokeville Formation Equivalent
Js - Stump Formation
Jp - Preuss Redbeds
Jt - Twin Creek Limestone
JTRn - Nugget Sandstone
TRa - Ankareh Formation
TRti - Timothy Sandstone
TRt - Thaynes Limestone
TRw - Woodside Shale
TRd - Dinwoody Formation
Pp - Phosphoria Formation
PPw - Wells Formation
Mc - Chesterfield Range Group
Mmc - Monroe Canyon Limestone
Ml - Lodgepole Limestone
Mm - Madison Limestone
Db - Beirdneau Formation
Du - Devonian Rocks Undivided
Sl - Laketown Dolomite
Of - Fish Haven Dolomite
Os - Swan Peak Quartzite
Og - Garden City Limestone
Cg - Gallatin Limestone
pCCb - Brigham Quartzite
RASMUSSEN VALLEY MINE
FIGURE 3.3-16
Regional Groundwater Flow Directions and Discharge Areas
ANALYSIS AREA: Caribou County, Idaho
Date: 6/23/2016
Prepared By: JC
File: KICO1553\2016_FEIS\Regional GW Flow Directions and Discharge Areas.mxd

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Table 3.3-7 Ranges of Concentrations for Constituents Exceeding Potentially Applicable Water Quality Standards in Intermittent Streams during Baseline Monitoring

Station	pH[1] (s.u.)			Arsenic[2] (mg/L)			Cadmium[3] (mg/L)			Copper[4] (mg/L)			Lead[5] (mg/L)			Selenium[6] (mg/L)		
	[7]	Low	High	[7]	low	high	[7]	low	high	[7]	low	high	[7]	low	high	[7]	low	high
SW-INT1	27	7.19	8.58	28	<0.0005	0.0011	28	<0.0001	0.0002	28	<0.0005	0.0029	28	<0.0001	0.00063	23	<0.0001	**0.011**
SW-INT1W	27	7.4	8.34	27	<0.0005	0.0011	27	<0.0001	0.0002	27	<0.0005	0.0011	27	<0.0001	0.0006	26	<0.0001	**0.0075**
SW-INT2	14	6.64	7.82	15	<0.0005	0.00064	15	<0.0001	<0.0001	15	<0.0005	0.0013	15	<0.0001	0.0005	12	<0.0001	0.00078
SW-INT3	19	6.68	8.54	20	0.0005	0.0019	20	<0.0001	0.00059	20	0.00051	0.0039	20	<0.0001	0.00064	16	0.00059	0.0027
SW-INT4	1	6.75	6.75	1	0.0010	0.0010	1	**0.0006**	**0.0006**	1	0.0026	0.0026	1	0.0004	0.0004	1	---	---
SW-INT4S	16	**5.73**	7.95	18	<0.0005	0.0013	18	<0.0001	0.00034	18	<0.0005	0.004	18	<0.0001	0.00082	14	0.0017	0.0029
SW-INT4X2	0	--	--	1	0.0024	0.0024	1	0.0005	0.0005	1	0.0023	0.0023	1	0.0002	0.0002	0	---	---
SW-INT4X3	22	**5.62**	**10.79**	25	0.0006	**0.022**	25	<0.0001	**0.0018**	25	<0.0005	**0.015**	25	<0.0001	**0.0043**	23	0.0013	0.0042
SW-INT6L	15	6.67	8.02	17	<0.0005	0.0021	17	<0.0001	0.0002	17	<0.0005	0.0019	17	<0.0001	0.0004	14	0.0002	0.00066
SW-INT8S	5	6.74	7.93	7	<0.0005	0.00073	7	<0.0001	<0.0001	7	0.0009	0.003	7	<0.0001	0.00096	4	<0.0001	0.0011
SW-INT9	2	7.40	7.46	2	<0.0005	0.0012	2	0.0001	0.0002	2	0.0009	0.0025	2	<0.0001	0.0002	1	0.0028	0.0028
SW-INT9X2	22	7.05	**9.31**	22	0.0005	0.0020	22	<0.0001	0.00029	22	<0.0005	0.004	22	<0.0001	0.0007	20	0.0005	**0.0067**
SW-INT10	26	**6.50**	**10.24**	26	0.0012	**0.013**	26	<0.0001	**0.0016**	26	0.0017	0.007	26	<0.0001	0.00054	26	0.0013	**0.0066**
SW-INT11	23	**6.13**	**10.74**	24	<0.0005	0.0078	24	<0.0001	0.00047	24	0.0014	0.0084	24	<0.0001	0.0019	24	0.0007	**0.0210**
SW-INT12	17	**6.42**	**9.45**	17	0.00086	**0.012**	17	<0.0001	0.0002	17	0.0017	0.0034	17	<0.0001	0.0019	17	0.00023	0.0015
SW-INT13	15	**5.77**	**9.20**	15	0.00059	**0.0114**	15	<0.0001	0.0005	15	0.0021	0.0046	15	<0.0001	0.0006	15	0.0003	0.0017
SW-INT14	6	6.62	7.84	6	<0.0005	0.00096	6	0.0002	0.00036	6	0.0012	0.0036	6	<0.0001	0.00068	6	0.0004	0.0013
SW-INT15	12	6.55	7.62	13	0.0005	0.0011	13	0.0002	0.0006	13	0.0012	0.0028	13	<0.0001	0.0004	13	0.0006	0.0035
SW-INT16	2	6.92	8.09	2	0.00064	0.00069	2	<0.0001	<0.0001	2	0.00094	0.0012	2	<0.0001	0.0003	2	<0.0001	<0.0001

Notes:

1 pH - numerical surface water standard is the range between 6.5 and 9.0

2 Dissolved arsenic - lowest numerical surface water standard is the human health-based criterion for consumption of water and organisms, 0.010 mg/L

3 Dissolved cadmium - lowest numerical surface water standard is the Idaho cold-water biota CCC, 0.0006 mg/L based on a hardness of 100 $CaCO_3$ mg/L and water effect ratio of 1

4 Dissolved copper - lowest numerical surface water standard is the Idaho cold-water biota CCC, 0.011 mg/L based on a hardness of 100 $CaCO_3$ mg/L and water effect ratio of 1

5 Dissolved lead - lowest numerical surface water standard for lead is the Idaho cold-water biota CCC, 0.0025 mg/L based on a hardness of 100 $CaCO_3$ mg/L and water effect ratio of 1

6 Total selenium - lowest numerical surface water standard is the Idaho cold-water biota CCC, 0.005 mg/L

7 The first column under each constituent lists the number of samples from that station

Table 3.3-8 Percentages of Samples Exceeding Potentially Applicable Water Quality Standards in Intermittent Streams during Baseline Monitoring

Station	pH		Arsenic		Cadmium		Copper		Lead		Selenium	
	Number of samples	Percent Meets or Exceeds Standard	Number of samples	Percent Meets or Exceeds Standard	Number of samples	Percent Meets or Exceeds Standard	Number of samples	Percent Meets or Exceeds Standard	Number of samples	Percent Meets or Exceeds Standard	Number of samples	Percent Meets or Exceeds Standard
SW-INT1	27	0.0	28	0.0	28	0.0	28	0.0	28	0.0	23	4.3
SW-INT1W	27	0.0	27	0.0	27	0.0	27	0.0	27	0.0	26	3.8
SW-INT2	14	0.0	15	0.0	15	0.0	15	0.0	15	0.0	12	0.0
SW-INT3	19	0.0	20	0.0	20	0.0	20	0.0	20	0.0	16	0.0
SW-INT4	1	0.0	1	0.0	1	100.0	1	0.0	1	0.0	1	0.0
SW-INT4S	16	6.2	18	0.0	18	0.0	18	0.0	18	0.0	14	0.0
SW-INT4X2	0	0.0	1	0.0	1	0.0	1	0.0	1	0.0	0	0.0
SW-INT4X3	22	40.9	25	20.0	25	16.0	25	4.0	25	4.0	23	0.0
SW-INT6L	15	0.0	17	0.0	17	0.0	17	0.0	17	0.0	14	0.0
SW-INT8S	5	0.0	7	0.0	7	0.0	7	0.0	7	0.0	4	0.0
SW-INT9	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	1	0.0
SW-INT9X2	22	4.5	22	0.0	22	0.0	22	0.0	22	0.0	20	5.0
SW-INT10	26	15.4	26	3.8	26	57.7	26	0.0	26	0.0	26	7.7
SW-INT11	23	30.4	24	0.0	24	0.0	24	0.0	24	0.0	24	4.2
SW-INT12	17	11.8	17	11.8	17	0.0	17	0.0	17	0.0	17	0.0
SW-INT13	15	26.7	15	6.7	15	0.0	15	0.0	15	0.0	15	0.0
SW-INT14	6	0.0	6	0.0	6	0.0	6	0.0	6	0.0	6	0.0
SW-INT15	12	0.0	13	0.0	13	0.0	13	0.0	13	0.0	13	0.0
SW-INT16	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0

Table 3.3-9 Ranges of Concentrations for Constituents Exceeding Potentially Applicable Water Quality Standards in Springs during Baseline Monitoring

Station	pH (field)[1] (s.u.)		Lead[2] (mg/L)		Selenium[3] (mg/L)		Thallium[4] (mg/L)		Zinc[5] (mg/L)	
	low	High	low	high	low	high	low	high	low	high
SW-SPRING1	**6.18**	8.56	<0.0001	0.0009	0.0003	0.00054	<0.0001	<0.0001	<0.0028	0.021
SW-SPRING2	**6.48**	7.70	<0.0001	0.0002	0.0009	**0.031**	<0.0001	<0.0001	<0.0028	0.01
SW-SPRING3	**6.15**	8.72	<0.0001	**0.0257**	<0.0001	0.00042	<0.0001	<0.0001	<0.0028	**0.15**
SW-SPRING4	**5.63**	7.37	<0.0001	0.00067	<0.0001	0.0017	<0.0001	<0.0001	<0.0028	0.01
SW-SPRING5	6.67	8.59	<0.0001	0.0003	0.00015	0.001	<0.0001	<0.0001	<0.0028	0.02
SW-SPRING6	7.05	8.69	<0.0001	0.0003	0.00016	0.00062	<0.0001	**0.0003**	<0.0028	0.01
SW-SPRING7	6.55	8.02	<0.0001	0.00034	0.00014	0.00054	<0.0001	<0.0001	<0.0028	0.0037
SW-SPRING8	6.60	7.99	<0.0001	0.00026	<0.0001	0.00032	<0.0001	<0.0001	<0.0028	0.0032
SW-SPRING9	6.73	7.68	<0.0001	<0.0001	<0.0001	0.00021	<0.0001	<0.0001	<0.0028	0.0043
SW-SPRING10	6.65	7.01	<0.0001	0.00013	0.00014	0.00075	<0.0001	<0.0001	<0.0028	<0.0028
SW-SPRING11	7.31	8.12	<0.0001	<0.0001	<0.0001	0.00035	<0.0001	<0.0001	<0.0028	0.0038
SW-SPRING12	6.96	7.75	<0.0001	0.0007	0.00011	0.00063	<0.0001	<0.0001	<0.0028	**0.66**
SW-SPRING13	7.49	8.27	<0.0001	<0.0001	<0.0001	0.00023	<0.0001	<0.0001	<0.0028	0.0042
SW-SPRING14	7.77	7.88	<0.0001	<0.0001	0.0003	0.0017	<0.0001	<0.0001	<0.0028	0.0057

Notes:

1 pH - numerical surface water standard is the range between 6.5 and 9.0

2 Dissolved lead - lowest numerical surface water standard is the Idaho cold-water biota CCC, 0.0025 mg/L based on a hardness of 100 $CaCO_3$ mg/L and water effect ratio of 1

3 Total selenium - lowest numerical surface water standard is the Idaho cold-water biota CCC, 0.005 mg/L

4 Dissolved thallium - lowest numerical surface water standard is the human health-based criterion for consumption of water and organisms, 0.00024 mg/L

5 Dissolved zinc - lowest numerical surface water standard is the Idaho cold-water biota CCC, 0.120 mg/L based on a hardness of 100 $CaCO_3$ mg/L and water effect ratio of 1

Table 3.3-10 Percentages of Samples Exceeding Potentially Applicable Water Quality Standards in Springs during Baseline Monitoring

Station	pH		Lead		Selenium		Thallium		Zinc	
	Number of samples	Percent Meets or Exceeds Standard	Number of samples	Percent Meets or Exceeds Standard	Number of samples	Percent Meets or Exceeds Standard	Number of samples	Percent Meets or Exceeds Standard	Number of samples	Percent Meets or Exceeds Standard
SW-SPRING1	32	6.3%	32	0.0%	29	0.0%	32	0.0%	32	0.0%
SW-SPRING2	11	9.1%	12	0.0%	12	16.7%	12	0.0%	12	0.0%
SW-SPRING3	24	8.3%	27	3.7%	27	0.0%	27	0.0%	27	3.7%
SW-SPRING4	10	40.0%	13	0.0%	13	0.0%	13	0.0%	13	0.0%
SW-SPRING5	20	0.0%	20	0.0%	20	0.0%	20	0.0%	20	0.0%
SW-SPRING6	14	0.0%	14	0.0%	14	0.0%	14	7.1%	14	0.0%
SW-SPRING7	8	0.0%	9	0.0%	9	0.0%	9	0.0%	9	0.0%
SW-SPRING8	8	0.0%	8	0.0%	8	0.0%	8	0.0%	8	0.0%
SW-SPRING9	9	0.0%	9	0.0%	9	0.0%	9	0.0%	9	0.0%
SW-SPRING10	2	0.0%	2	0.0%	2	0.0%	2	0.0%	2	0.0%
SW-SPRING11	10	0.0%	10	0.0%	10	0.0%	10	0.0%	10	0.0%
SW-SPRING12	9	0.0%	9	0.0%	9	0.0%	9	0.0%	9	11.1%
SW-SPRING13	10	0.0%	10	0.0%	10	0.0%	10	0.0%	10	0.0%
SW-SPRING14	2	0.0%	2	0.0%	2	0.0%	2	0.0%	2	0.0%

3.3.2.1.2 Intermediate-Scale Groundwater Flow Systems

The Dinwoody Formation and the Rex Chert host intermediate-scale aquifers within the Study Area. Intermediate-scale aquifers recharge and discharge within the same basin and have the capacity to store and transmit appreciable amounts of groundwater to adjacent geologic formations, springs, and surface water bodies (Cannon and Ralston 1980; Ralston et al. 1983). The intermediate flow system in the Dinwoody Formation may be separated from the Rex Chert by the Cherty Shale, which acts as an aquitard where the unit is well developed and not fractured. Groundwater flow within the Study Area in intermediate-scale aquifers is generally southwest, following bedding and topography away from outcrop recharge areas adjacent and parallel to the axis of the Snowdrift Anticline. Groundwater flow in the intermediate flow systems is expected to be downdip towards the Enoch Valley Fault (**Figure 3.3-17**). In addition, there are minor faults present within the Study Area that could provide localized hydraulic connections between intermediate- and regional-scale flow systems.

3.3.2.1.3 Local-Scale Groundwater Flow Systems

Within the Study Area, local-scale groundwater flow systems are relatively shallow and are generally located in Quaternary alluvium and colluvium deposits. A local groundwater flow system is typically characterized by short flow paths and with relatively small quantities of water in storage. The groundwater in the local-scale systems is usually unconfined and flows from higher elevations to lower elevations. Specifically, local groundwater flows from the ridge crest of the Snowdrift Anticline towards Angus Creek and to the northeast within the Study Area. Local-scale groundwater flows primarily in the lateral directions due to the associated anisotropy in hydraulic conductivity (i.e., lateral hydraulic conductivity much greater than vertical hydraulic conductivity) within aquifers. There is likely minor leakage between local- and intermediate-scale groundwater flow systems within the Study Area.

3.3.2.1.4 Groundwater Recharge

Recharge to groundwater occurs by infiltration of precipitation in topographically high areas. Precipitation in the region occurs primarily as snow, with the greatest accumulations occurring on east sides of the ridges (Ralston et al. 1977). West-facing slopes and valley floors receive less snow or have the snow blown off the slopes or lost through sublimation, and have lower recharge potentials than east-facing slopes. Infiltration of precipitation and snowmelt along the crest and slopes of Rasmussen Ridge plays a key role in recharging aquifer systems in the Study Area. The estimated average recharge for the Study Area, based on the average annual precipitation of 23.41 inches (Whetstone 2014), is 2.6 inches per year (i.e., 11 percent of annual precipitation). Estimated average recharge values for groundwater in the Southeast Idaho Phosphate District as a function of precipitation are summarized in **Table 3.3-11** (Buck and Mayo 2004).

Table 3.3-11 Estimated Recharge to Groundwater in Southeast Idaho

Annual Precipitation	Percent Recharge
0 to 12 in/yr	0
12 to 16 in/yr	4
16 to 20 in/yr	7
20 to 25 in/yr	11
25 to 30 in/yr	14
30 to 35 in/yr	18
> 35 in/yr	21

Source: Buck and Mayo 2004

Recharge to groundwater in the Study Area may also occur by leakage from streams. Although the results of the gain-loss studies on the Blackfoot River were inconclusive, the elevation of the river where it crosses the southern portion of the Study Area is approximately 6,430 feet, which is about 100 feet higher than the water level in the Wells Regional Aquifer at approximately 6,333 feet. Gain-loss studies for Angus Creek indicate that it is a losing stream during the low-flow season when it provides recharge to the underlying alluvial aquifer.

3.3.2.2 Groundwater Data

Groundwater data for the region are available from reports, maps, and databases prepared by the USGS, the Idaho Department of Water Resources (IDWR), and other public domain sources. These data are supplemented by a site-specific groundwater investigation completed under the direction of the Agencies (Whetstone 2015b). The baseline groundwater investigation for the Study Area included:

- Installation of 20 wells and 11 vibrating wire piezometers (VWPs) within the Study Area
- Quarterly monitoring (spring through fall) of groundwater levels and water quality, starting April 1, 2012 and extending through December 31, 2014
- Single-well permeability tests (pneumatic slug, and pump and recovery tests) in 13 monitoring wells
- An aquifer test in the Wells Regional Aquifer near the southeastern end of the proposed pit

A list of wells and VWPs installed for baseline monitoring is presented in **Table 3.3-12**. Construction details for monitoring wells and VWPs are presented in **Table 3.3-13** and **Table 3.3-14**. Locations of baseline monitoring wells and VWPs are shown on **Figure 3.3-17**.

3.3.2.2.1 Hydrologic Characteristics of Bedrock and Unconsolidated Deposits

Hydraulic conductivity, transmissivity, and storage data for bedrock and unconsolidated deposits in the Study Area were obtained from an aquifer test in the Wells Regional Aquifer and permeability tests performed in 13 wells. Additional hydrogeologic data for the project were also evaluated from studies at other phosphate mines in the region. Hydraulic conductivity (K) is the permeability of a rock mass or unconsolidated deposit with respect to water. It is reported in units of distance over time (i.e., feet per day [ft/day]). Transmissivity (T) is the rate at which water can be transmitted through a unit width of an aquifer under a unit hydraulic gradient and is equal to hydraulic conductivity multiplied by the thickness (b) of the aquifer (i.e., T=Kb in units of length squared over time [ft^2/day]). Storage is a dimensionless value that is defined as the volume of water an aquifer releases or takes into storage per unit surface area of the aquifer for a unit change in head. In a confined aquifer, storage values (storativity [S]) are typically small (0.005 to 0.00005), and changes in storage are controlled by the expansion and contraction of the water and the mineral skeleton (i.e. aquifer solids) (Freeze and Cherry 1979). Storage values for unconfined aquifers (specific yield [Sy]) are typically much larger than those for confined aquifers (0.3 to 0.01) and reflect filling or dewatering of pore spaces as the water table rises or falls (Freeze and Cherry 1979).

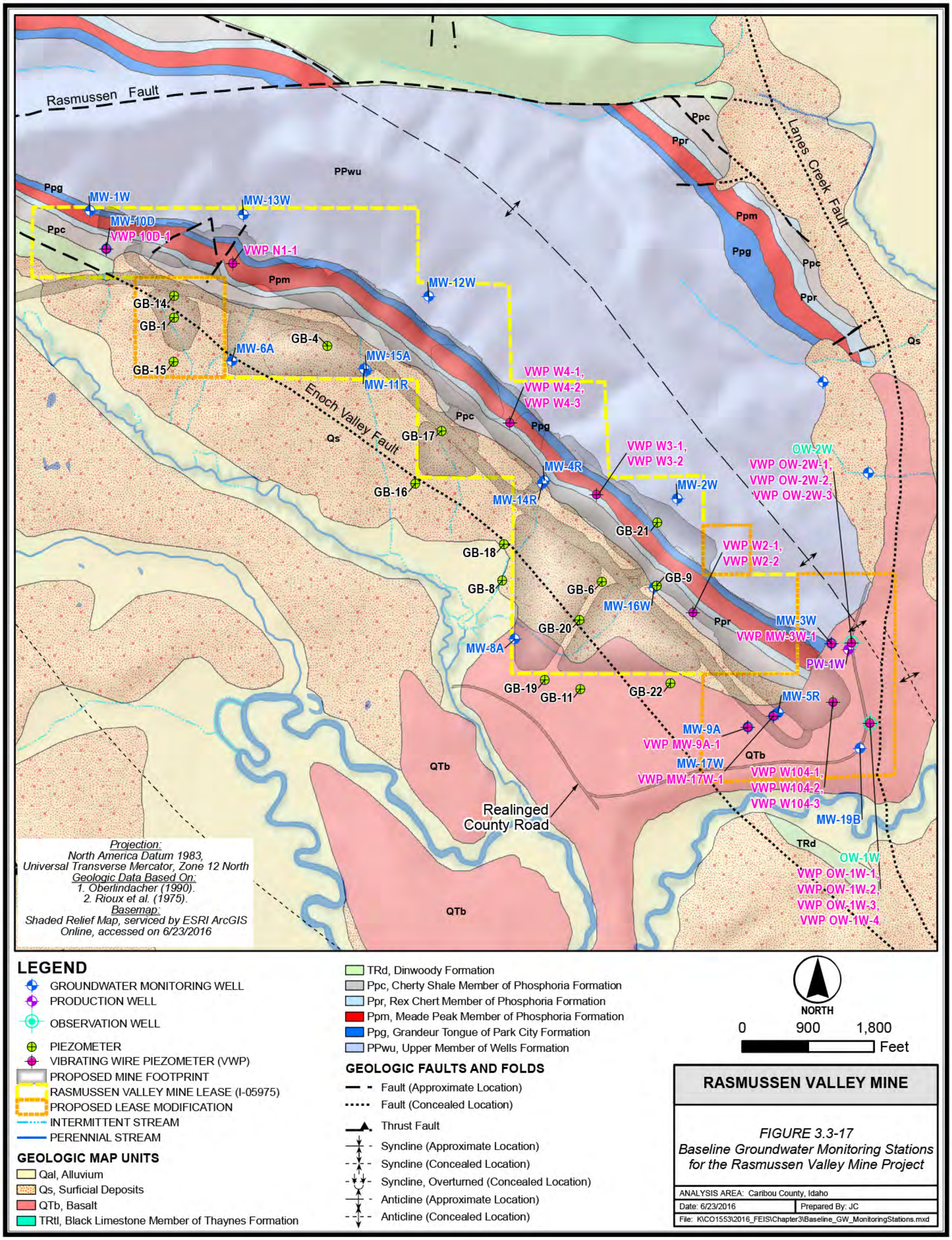
Rasmussen Fault
Lanes Creek Fault
Enoch Valley Fault
PPwu
Ppg
Ppc
Ppm
Ppr
Qs
QTb
TRd
MW-1W
MW-13W
MW-10D
VWP 10D-1
VWP N1-1
MW-12W
GB-14
GB-1
GB-15
GB-4
MW-6A
MW-15A
MW-11R
VWP W4-1,
VWP W4-2,
VWP W4-3
GB-17
VWP W3-1,
VWP W3-2
MW-4R
MW-14R
MW-2W
GB-16
GB-21
GB-18
VWP W2-1,
VWP W2-2
GB-8
GB-6
GB-9
MW-16W
GB-20
MW-8A
MW-3W
VWP MW-3W-1
PW-1W
GB-19
GB-11
GB-22
MW-5R
MW-9A
VWP MW-9A-1
MW-17W
VWP MW-17W-1
VWP W104-1,
VWP W104-2,
VWP W104-3
MW-19B
OW-2W
VWP OW-2W-1,
VWP OW-2W-2,
VWP OW-2W-3
OW-1W
VWP OW-1W-1,
VWP OW-1W-2,
VWP OW-1W-3,
VWP OW-1W-4
Realigned County Road
Projection:
North America Datum 1983,
Universal Transverse Mercator, Zone 12 North
Geologic Data Based On:
1. Oberlindacher (1990).
2. Rioux et al. (1975).
Basemap:
Shaded Relief Map, serviced by ESRI ArcGIS Online, accessed on 6/23/2016
LEGEND
GROUNDWATER MONITORING WELL
PRODUCTION WELL
OBSERVATION WELL
PIEZOMETER
VIBRATING WIRE PIEZOMETER (VWP)
PROPOSED MINE FOOTPRINT
RASMUSSEN VALLEY MINE LEASE (I-05975)
PROPOSED LEASE MODIFICATION
INTERMITTENT STREAM
PERENNIAL STREAM
GEOLOGIC MAP UNITS
Qal, Alluvium
Qs, Surficial Deposits
QTb, Basalt
TRtl, Black Limestone Member of Thaynes Formation
TRd, Dinwoody Formation
Ppc, Cherty Shale Member of Phosphoria Formation
Ppr, Rex Chert Member of Phosphoria Formation
Ppm, Meade Peak Member of Phosphoria Formation
Ppg, Grandeur Tongue of Park City Formation
PPwu, Upper Member of Wells Formation
GEOLOGIC FAULTS AND FOLDS
Fault (Approximate Location)
Fault (Concealed Location)
Thrust Fault
Syncline (Approximate Location)
Syncline (Concealed Location)
Syncline, Overturned (Concealed Location)
Anticline (Approximate Location)
Anticline (Concealed Location)
NORTH
0 900 1,800
Feet
RASMUSSEN VALLEY MINE
FIGURE 3.3-17
Baseline Groundwater Monitoring Stations for the Rasmussen Valley Mine Project
ANALYSIS AREA: Caribou County, Idaho
Date: 6/23/2016
Prepared By: JC
File: K:\CO1553\2016_FEIS\Chapter3\Baseline_GW_MonitoringStations.mxd

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Table 3.3-12 Summary of Baseline Monitoring Wells and Vibrating Wire Piezometers for the Rasmussen Valley Mine Project

Well ID	Location	Type
Alluvium and Basalt		
MW-6A	Western edge of proposed North Overburden Pile	Monitoring well
MW-8A	Between South Main and South-South overburden piles	Monitoring well
MW-9A	Southern Study Area alluvium below basalt flows	Monitoring well
MW-15A	Eastern edge of proposed North Overburden Pile	Monitoring well
MW-19B	Basalt and alluvium south of proposed pit	Monitoring well
MW-9A-1	Southern Study Area in alluvium below basalt flows	VWP
OW-1W-4	Between proposed pit and Blackfoot River	VWP
Dinwoody Fm.		
MW-10D	Northern Study Area southwest of proposed pit	Monitoring well
VWP-10D-1	Northern Study Area southwest of proposed pit	VWP
Rex Chert		
MW-4R	South central Study Area west of proposed pit	Monitoring well
MW-5R	Southern Study Area south of proposed pit	Monitoring well
MW-11R	Eastern edge of proposed North Overburden Pile	Monitoring well
MW-14R	South central Study Area west of proposed pit	Monitoring well
VWP W104-3	Southern Study Area within footprint of proposed pit	VWP
OW-1W-2	Between proposed pit and Blackfoot River	VWP
OW-1W-3	Between proposed pit and Blackfoot River	VWP
Meade Peak		
VWP W2-2	Southern Study Area within footprint of proposed pit	VWP
VWP W4-2	Central Study Area within footprint of proposed pit	VWP
VWP W4-3	Central Study Area within footprint of proposed pit	VWP
VWP W104-2	Southern Study Area within footprint of proposed pit	VWP
MW-17W-1	Southern Study Area southwest of proposed pit	VWP
Grandeur Tongue		
MW-16W	Southern Study Area southwest of proposed pit	Monitoring well
MW-17W	Southern Study Area southwest of proposed pit	Monitoring well
VWP N1-1	Northern Study Area within footprint of proposed pit	VWP
VWP W2-1	Southern Study Area within footprint of proposed pit	VWP
VWP W3-1	Central Study Area within footprint of proposed pit	VWP
VWP W3-2	Central Study Area within footprint of proposed pit	VWP
OW-1W-1	Between proposed pit and Blackfoot River	VWP
Wells Formation		
MW-1W	Northwest end of proposed pit	Monitoring well
MW-2W	South central Study Area east of proposed pit	Monitoring well
MW-3W	Southern Study Area east of proposed pit	Monitoring well
MW-12W	North central Study Area north of proposed pit	Monitoring well
MW-13W	North central Study Area north of proposed pit	Monitoring well
PW-1W	Between proposed pit and Blackfoot River	Production well
OW-1W	Between proposed pit and Blackfoot River	Observation well
OW-2W	Between proposed pit and Blackfoot River	Observation well
VWP N1-1	Northern Study Area within footprint of proposed pit	VWP
VWP W2-1	Southern Study Area within footprint of proposed pit	VWP
VWP W3-1	Central Study Area within footprint of proposed pit	VWP
VWP W3-2	Central Study Area within footprint of proposed pit	VWP
VWP W4-1	Central Study Area within footprint of proposed pit	VWP
VWP W104-1	Southern Study Area within footprint of proposed pit	VWP
MW-3W-1	Southern Study Area east of proposed pit	VWP
OW-2W-1	Between proposed pit and Blackfoot River	VWP
OW-2W-2	Between proposed pit and Blackfoot River	VWP
OW-2W-3	Between proposed pit and Blackfoot River	VWP

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Table 3.3-13 Summary of Well Construction Details

Well ID	Monitored Formation	Coordinate Location Northing (m)	Easting (m)	Casing Top Elev. (ft amsl)	Depth (ft btoc)	Diameter (in)	Type	Screened Interval Top (ft btoc)	Bottom (ft btoc)	Length (ft)	Completion Water Level DTW (ft btoc)	Date Measured
MW-1W	Wells Fm.	4,743,794.02	470,858.44	6,762.54	486.59	4	SS	441.99	481.99	40	214.93	9/25/12
MW-2W	Wells Fm.	4,742,596.03	473,303.92	6,852.06	566.96	4	SS	541.96	561.96	20	513.07	7/1/12
MW-3W	Wells Fm.	4,741,992.42	473,945.16	6,570.41	262.58	4	PVC	237.58	257.58	20	235.58	1/10/11
MW-4R	Rex Chert	4,742,671.88	472,749.31	6,567.31	181.10	4	SS	156.10	176.10	20	Flowing	7/26/11
MW-5R	Rex Chert	4,741,706.82	473,724.08	6,552.11	276.83	4	PVC	251.83	271.83	20	62.23	1/10/11
MW-6A	Alluvium	4,743,169.24	471,449.09	6,584.89	67.42	4	PVC	42.42	62.42	20	59.51	8/9/12
MW-8A	Alluvium	4,742,010.63	472,626.63	6,461.20	71.76	4	PVC	46.76	66.76	20	21.61	8/30/11
MW-9A	Alluvium	4,741,644.67	473,598.46	6,544.58	91.63	4	PVC	64.63	84.63	20	50.63	1/10/11
MW-10D	Dinwoody	4,743,638.45	470,925.59	6,636.86	137.29	4	PVC	72.29	132.29	60	71.46	2/28/12
MW-11R	Rex Chert	4,743,135.31	472,000.31	6,701.24	292.07	4	SS	267.07	287.07	20	191.15	8/1/12
MW-12W	Wells Fm.	4,743,437.25	472,269.09	6,883.39	640.92	4	SS	615.92	635.92	20	546.12	8/17/12
MW-13W	Wells Fm.	4,743,779.58	471,496.93	7,043.47	767.03	4	SS	742.03	762.03	20	707.05	8/17/12
MW-14R	Rex Chert	4,742,660.82	472,742.31	6,566.10	56.89	4	PVC	31.89	51.89	20	10.54	7/27/11
MW-15A	Alluvium	4,743,132.37	472,008.95	6,700.92	42.99	4	PVC	17.99	37.99	20	Dry	6/28/12
MW-16W	Grandeur	4,742,224.63	473,207.18	6,678.66	783.71	4	SS	758.71	778.71	20	208.04	2/14/12
MW-17W	Grandeur	4,741,690.43	473,704.48	6,551.95	768.20	4	SS	743.20	763.20	20	180.07	11/16/11
MW-19B	Basalt	4,741,556.25	474,064.33	6,520.63	67.13	2	PVC	32.13	62.13	30	Dry	6/6/12
OW-1W	Wells Fm.	4,741,661.02	474,106.50	6,531.21	514.85	4	SS	419.85	509.85	90	223.2	11/8/12
OW-2W	Wells Fm.	4,741,996.56	474,030.25	6,557.54	316.15	4	SS	221.15	311.15	90	173.63	10/3/11
PW-1W	Wells Fm.	4,741,968.41	474,017.56	6,558.42	375.03	10	SS	220.03	370.03	150	219.79	10/4/12

Notes:

Coordinate location system is North American Datum of 1983 (NAD 83), Universal Transverse Mercator (UTM) meters, Zone 12 North.

amsl = above mean sea level

ags = above ground surface

btoc = below top of casing

SS = stainless steel

PVC = polyvinyl chloride

Table 3.3-14 Summary of Vibrating Wire Piezometer Construction Details

VWP ID	Monitored Formation	Collar Coordinate Location Northing (m)	Collar Coordinate Location Easting (m)	Instrument Location Notes Depth (ft bgs)	Instrument Location Notes Elevation (ft amsl)	Instrument Location Notes Placement Notes	Completion Water Level and Temperature DTW (ft bgs)	Completion Water Level and Temperature Temp. (°C)	Completion Water Level and Temperature Date Measured
N1-1*	Grandeur	471,453.47	4,743,577.28	350	6,512.6	Grouted in place in cored borehole	321.55	NA	12/9/2010
W104-1	Grandeur	473,953.44	4,741,748.47	465	6,176.3	Grouted in place in cored borehole	219.74	14.2	8/18/2010
W104-2	Meade Peak	473,953.44	4,741,748.47	320	6,351.3	Grouted in place in cored borehole	119.49	10.3	8/18/2010
W104-3	Rex Chert	473,953.44	4,741,748.47	200	6,471.3	Grouted in place in cored borehole	81.06	8.7	8/18/2010
W2-1*	Grandeur	473,369.24	4,742,121.44	379.3	6,371.5	Grouted in place in cored borehole	300.65	13.5	7/19/2010
W3-1*	Grandeur	472,967.31	4,742,612.20	360	6,446.0	Grouted in place in cored borehole	327.46	17.1	8/7/2010
W3-2*	Grandeur	472,967.31	4,742,612.20	360	6,446.0	Grouted in place in cored borehole	331.28	17.4	8/7/2010
W4-1*	Wells Fm.	472,606.70	4,742,912.13	465	6,349.6	Grouted in place in cored borehole	444.06	17.5	7/16/2010
W4-2*	Meade Peak	472,606.70	4,742,912.13	320	6,492.4	Grouted in place in cored borehole	331.62	27.4	7/16/2010
W4-3*	Meade Peak	472,606.70	4,742,912.13	200	6,610.6	Grouted in place in cored borehole	162.11	12.6	7/25/2010
MW-3W-1	Wells Fm.	4,741,992.42	473,945.16	240	6,328.8	At top of well screen in filter pack	233.6	22.9	5/24/2011
MW-9A-1	Alluvium	4,741,644.67	473,598.46	63	6,480.0	Adjacent to well screen in filter pack	52.63	7.3	12/22/2010
MW-10D-1	Dinwoody	4,743,638.45	470,925.59	330	6,304.6	Grouted in annulus adjacent to well casing	71.44	14.5	2/22/2012
MW-17W-1	Meade Peak	4,741,690.43	473,704.48	550	5,998.8	Grouted in annulus adjacent to well casing	168.5	14.2	12/16/2011
OW-1W-1	Grandeur	4,741,996.56	474,030.25	385	6,144.4	Grouted in annulus adjacent to well casing	170.93	11.3	10/8/2011
OW-1W-2	Rex Chert	4,741,996.56	474,030.25	257	6,272.4	Grouted in annulus adjacent to well casing	159.11	10.8	10/8/2011
OW-1W-3	Rex Chert	4,741,996.56	474,030.25	197	6,332.4	Grouted in annulus adjacent to well casing	154.79	8.7	10/8/2011
OW-1W-4	Alluvium	4,741,996.56	474,030.25	137	6,392.4	Grouted in annulus adjacent to well casing	88.2	8.7	10/8/2011
OW-2W-1	Wells Fm.	4,741,968.41	474,017.56	325	6,230.4	Grouted in borehole below constructed well	215.53	27.3	11/14/2015
OW-2W-2	Wells Fm.	4,741,968.41	474,017.56	345	6,210.4	Grouted in borehole below constructed well	222.66	28.8	11/14/2015
OW-2W-3	Wells Fm.	4,741,968.41	474,017.56	365	6,190.4	Grouted in borehole below constructed well	212.04	29.5	11/14/2015

Notes:

Coordinate location system is NAD 83, UTM meters, Zone 12 North.

amsl = above mean sea level

bgs = below ground surface

btoc = below top of casing

* VWP installed in angled borehole. Groundwater depths are corrected for inclination

Single-Well Permeability Tests

Short-duration single-well permeability tests were performed in 13 wells to provide data for the calculation of the hydraulic conductivity of rocks and unconsolidated deposits in the Study Area. The tests were performed by one of three methods: pneumatic slug tests, mechanical slug tests, or pump and recovery tests. Pneumatic slug test were performed by attaching an air-tight assembly with a pressure release valve to the well heads, closing the valve to shut the wells from the outside atmosphere, depressing or increasing the water levels in the wells with compressed air or a vacuum, and then monitoring the recovery of water levels upon release of the air slugs. Three to ten pneumatic slug tests were performed in each well. Three mechanical slug tests were performed in wells MW-8A and MW-14R by lowering a PVC cylinder (slug) into the well, waiting for the water level to stabilize, and then removing the slug rapidly and monitoring the subsequent recovery of the water level. Pump and recovery tests were performed by pumping the wells for several hours while monitoring the discharge rate. The recoveries of water levels were monitored at the end of pumping to provide data that could be used to calculate hydraulic conductivity. Complete descriptions of the testing procedures and data analysis are presented in the Water Resources Baseline Characterization Report (Whetstone 2015b). The results of the tests are summarized in **Table 3.3-15**.

Table 3.3-15 Summary of Single Well Permeability Tests for the Rasmussen Valley Mine Project

Well	Test Type	Hydraulic Conductivity (ft/day)	
		Range of Calculated Values	**Best Estimate**
Alluvium			
MW-8A	Mechanical slug	10.7 – 46.8	17.3
MW-9A	Pneumatic slug	6.9 – 13.5	9.0
Dinwoody Fm.			
MW-10D	Pump and recovery	2.2 – 2.4	2.3
Rex Chert			
MW-4R	Pneumatic slug	0.36 – 1.8	0.50
MW-5R	Pneumatic slug	10.6 – 21.6	16.4
MW-14R	Mechanical slug	0.11 – 0.35	0.20
Grandeur Tongue			
MW-16W	Pump and recovery	0.2 – 2.4	2.1
MW-17W	Pump and recovery	8.6	8.6
Wells Formation			
MW-1W	Pump and recovery	0.04 – 0.12	0.06
MW-2W	Pneumatic slug	4.7 – 18.7	5.3
MW-3W	Pneumatic slug	14.0 – 60.7	17.7
MW-12W	Pneumatic slug	0.41 – 2.4	0.69
OW-1W	Pneumatic slug	1.9 – 7.7	2.6

Aquifer Test in the Wells Regional Aquifer

An aquifer test was performed in the Wells Regional Aquifer to develop reliable estimates of transmissivity, hydraulic conductivity, and storage. The test consisted of a 7.5-hour step-drawdown test and a 72-hour constant-rate discharge test (BC 2013c). The pumped well (PW-1W) was screened across the water table in an unconfined section of the Wells Formation near the south end of the proposed pit. The response to pumping during the aquifer test was monitored in 22 wells and eight VWPs (**Figure 3.3-17**).

The step-drawdown test was completed on November 19, 2012 by pumping well PW-1W at four consecutively higher discharge rates (250, 357, 453, and 541 gallons per minute [gpm]) while monitoring water level changes in the pumping well, observation wells, and VWPs. The first three pumping steps were performed for 2 hours each. The duration of the fourth step was 1.5 hours. At the end of the last step, the pump was shut off, and the recovery of water levels in the aquifer was monitored for 16 hours. Data from the step-drawdown test were used to evaluate the efficiency of the pumping well and to determine the sustainable pumping rate for the constant-rate discharge test. The efficiency of the pumping well was initially estimated to be 21 percent at a discharge rate of 500 gallons per minute (gpm). This estimate was later modified to 31 percent based on a distance-drawdown analysis of data from the constant-rate test. The observed maximum drawdown in the pumping well at the end of the step-drawdown test was 26.89 feet which is corrected to 8.34 feet based on 31 percent well efficiency.

The constant-rate discharge test was completed between December 11 and 14, 2012 by pumping PW-1W for 72 hours at an average rate of 504 gpm. Water levels in the pumping well, observation wells, and VWPs were monitored during pumping, and for an additional 96 hours after the pump had been shut off. The drawdown in PW-1W approached steady-state conditions near the end of the pumping period and was 7.98 feet after correcting for 31 percent well efficiency (**Figure 3.3-17**). Data from the pumping well and observations wells were analyzed using methods by Moench (1984) and Theis (1935), which returned T values ranging from approximately 14,400 to 17,300 ft^2/day. Estimates of K ranged from 94 to 113 ft/day with a geometric mean of 105 ft/day. The estimated range of storage values was 0.016 to 0.007 (unitless).

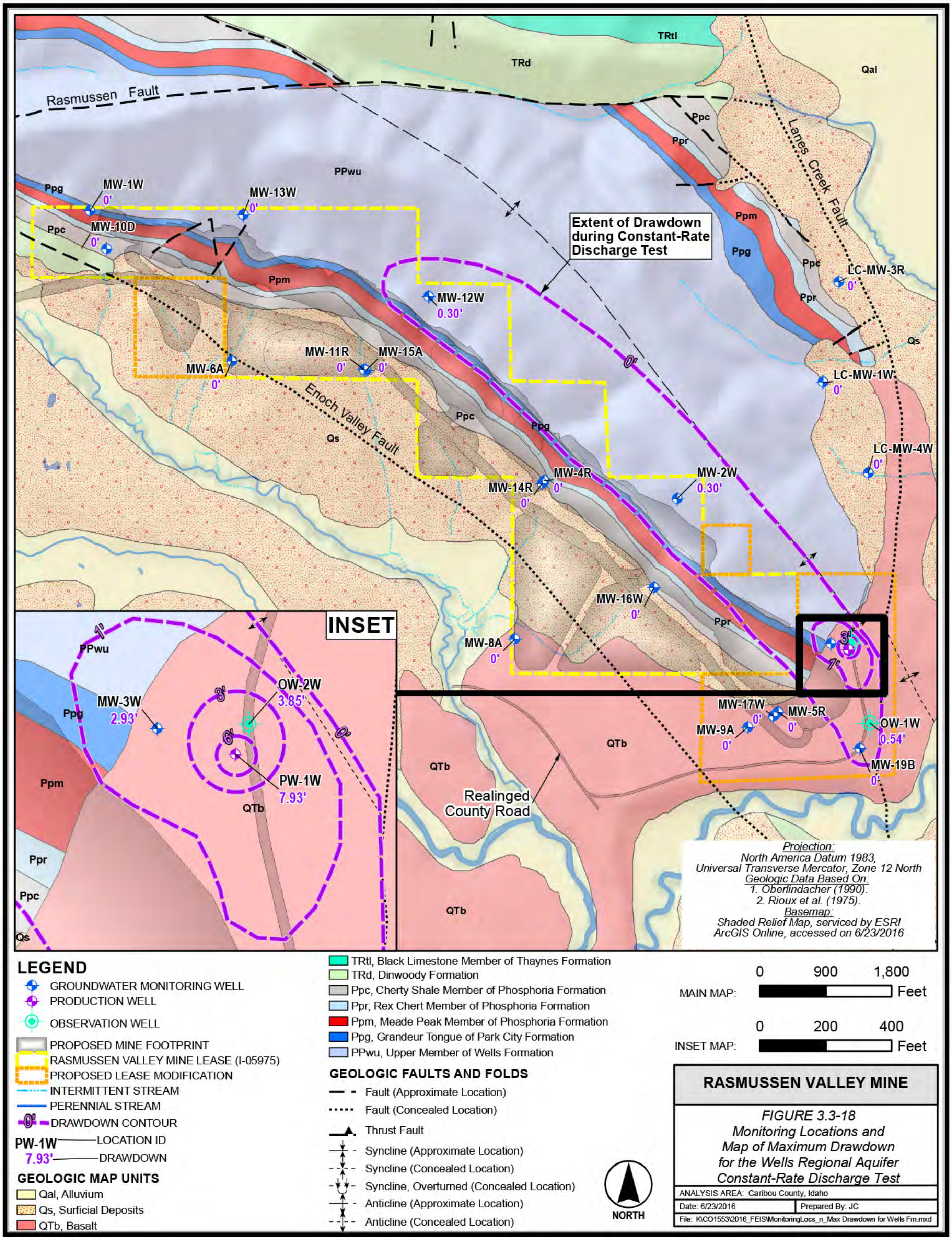
Drawdown data from the constant-rate discharge test indicated that hydraulic properties of the Wells Regional Aquifer are anisotropic (i.e., different in different directions). The calculated anisotropy ratio of the aquifer was 14.8:1, with the axis of highest K being oriented parallel to the strike of bedding (north 60° west) and the axis of lowest permeability being oriented perpendicular to the strike of bedding. A map showing drawdown in the Wells Regional Aquifer at the end of the constant-rate discharge test is presented on **Figure 3.3-18**.

<u>Regional Hydrologic Parameters</u>

Hydrologic data, including T, K, and storage coefficients, have been developed for a number of phosphate mining sites in the region. Whetstone compiled regional data in 2010. This compilation, presented in **Table 3.3-16**, has been updated with additional information from recent testing at the North Rasmussen Ridge (BC 2014a) and Blackfoot Bridge Mines (Whetstone 2009). The results indicate that K varies widely in bedrock, often spanning two or more orders of magnitude for each unit. This type of variability is typical for fracture flow systems.

<u>Groundwater Levels and Direction of Flow in the Study Area</u>

Data from monitoring wells MW-2W, MW-3W, MW-12W, and MW-13W indicate that the regional groundwater elevation in the Wells Regional Aquifer ranges from approximately 6,330 to 6,340 feet amsl at Rasmussen Valley. The planned minimum elevation of the open pit for the Proposed Action is 6,280 feet amsl, and the southern portion of the pit would extend 50 to 60 feet below the regional water level (Agrium 2011). The lowest portion of the pit for the Rasmussen Collaborative Alternative (RCA) would be near the top of the regional water table, but would not extend below it. Groundwater elevations in the Wells Regional Aquifer vary seasonally with an observed annual fluctuation of 3.4 feet (Whetstone 2015b). The general direction of groundwater flow in the Wells Regional Aquifer is northwest, with a gradient of 0.0003 ft/ft between monitoring wells MW-3W and MW-13W (**Figure 3.3-19**).



Rasmussen Fault
TRtl
TRd
Qal
PPwu
Ppc
Ppr
Ppm
Ppg
Lanes Creek Fault
MW-1W
0'
MW-13W
0'
MW-10D
0'
Extent of Drawdown during Constant-Rate Discharge Test
LC-MW-3R
0'
MW-12W
0.30'
Qs
MW-11R
0'
MW-15A
0'
MW-6A
0'
LC-MW-1W
0'
Enoch Valley Fault
LC-MW-4W
0'
MW-4R
0'
MW-14R
0'
MW-2W
0.30'
MW-16W
0'
MW-8A
0'
INSET
1'
3'
6'
0'
MW-3W
2.93'
OW-2W
3.85'
PW-1W
7.93'
QTb
MW-17W
0'
MW-5R
0'
MW-9A
0'
OW-1W
0.54'
MW-19B
0'
Realinged County Road
Projection:
North America Datum 1983,
Universal Transverse Mercator, Zone 12 North
Geologic Data Based On:
1. Oberlindacher (1990).
2. Rioux et al. (1975).
Basemap:
Shaded Relief Map, serviced by ESRI
ArcGIS Online, accessed on 6/23/2016
LEGEND
GROUNDWATER MONITORING WELL
PRODUCTION WELL
OBSERVATION WELL
PROPOSED MINE FOOTPRINT
RASMUSSEN VALLEY MINE LEASE (I-05975)
PROPOSED LEASE MODIFICATION
INTERMITTENT STREAM
PERENNIAL STREAM
DRAWDOWN CONTOUR
PW-1W LOCATION ID
7.93' DRAWDOWN
GEOLOGIC MAP UNITS
Qal, Alluvium
Qs, Surficial Deposits
QTb, Basalt
TRtl, Black Limestone Member of Thaynes Formation
TRd, Dinwoody Formation
Ppc, Cherty Shale Member of Phosphoria Formation
Ppr, Rex Chert Member of Phosphoria Formation
Ppm, Meade Peak Member of Phosphoria Formation
Ppg, Grandeur Tongue of Park City Formation
PPwu, Upper Member of Wells Formation
GEOLOGIC FAULTS AND FOLDS
Fault (Approximate Location)
Fault (Concealed Location)
Thrust Fault
Syncline (Approximate Location)
Syncline (Concealed Location)
Syncline, Overturned (Concealed Location)
Anticline (Approximate Location)
Anticline (Concealed Location)
NORTH
MAIN MAP: 0 900 1,800 Feet
INSET MAP: 0 200 400 Feet
RASMUSSEN VALLEY MINE
FIGURE 3.3-18
Monitoring Locations and Map of Maximum Drawdown for the Wells Regional Aquifer Constant-Rate Discharge Test
ANALYSIS AREA: Caribou County, Idaho
Date: 6/23/2016
Prepared By: JC
File: K:\CO1553\2016_FEIS\MonitoringLocs_n_Max Drawdown for Wells Fm.mxd

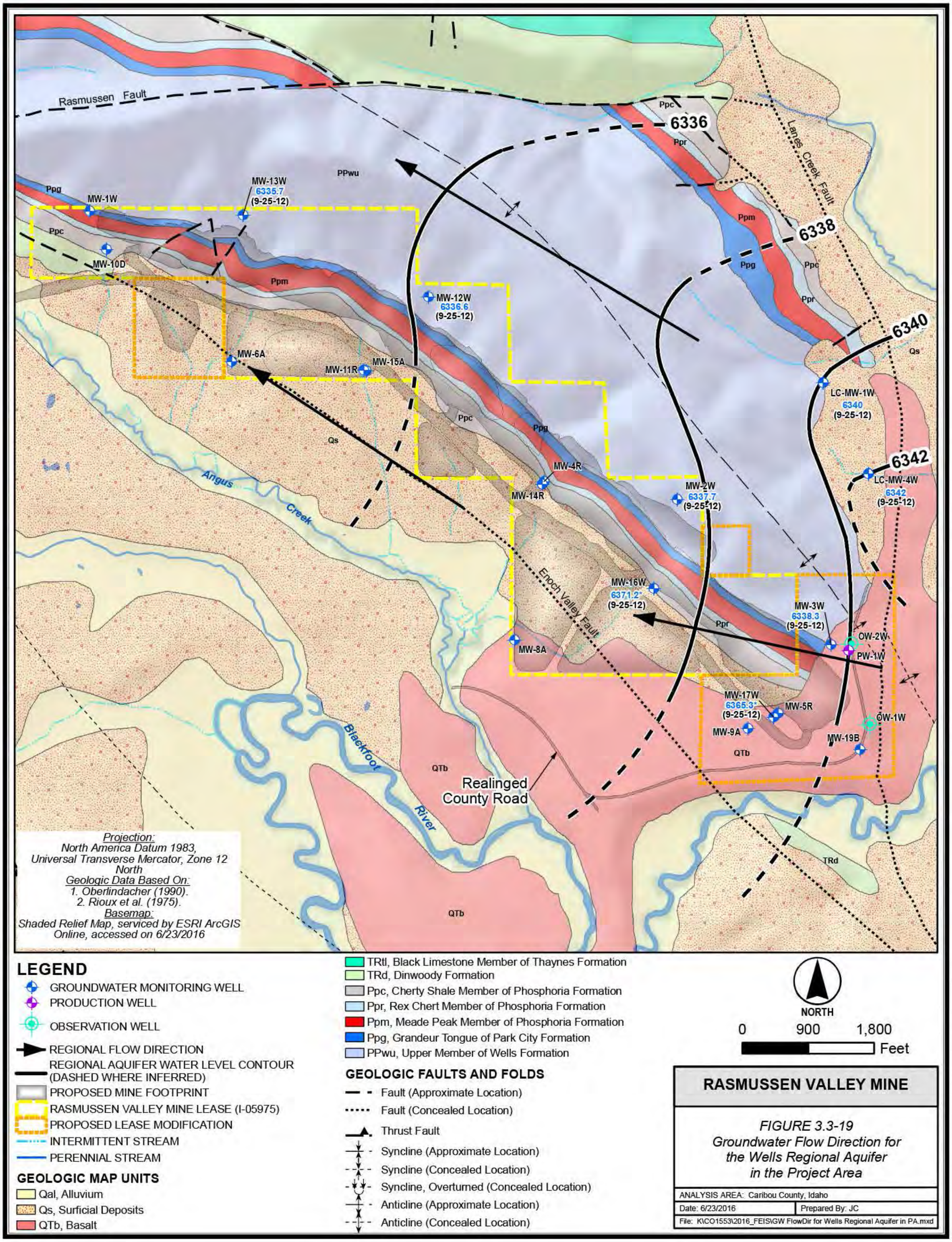


FIGURE 3.3-19
Groundwater Flow Direction for the Wells Regional Aquifer in the Project Area

Table 3.3-16 Summary of Regional Data for Hydraulic Conductivity, Transmissivity, and Storage

Geologic Unit	Aquifer Property	Units	Minimum	Maximum	Average	Median	Geometric Mean	Standard Deviation	Number of Tests
Alluvium	K	ft/day	0.01	55	8.5	0.1	0.3	20.5	7
	T	ft^2/day	3,200	3,200	3,200	3,200	3,200	N/A	1
	Storage	Unitless	N/A	N/A	N/A	N/A	N/A	N/A	0
Dinwoody Formation	K	ft/day	N/A	N/A	N/A	N/A	N/A	N/A	0
	T	ft^2/day	83	620	352	380	227	352	2
	Storage	Unitless	N/A	N/A	N/A	N/A	N/A	N/A	0
Rex Chert	K	ft/day	0.1	8.3	2.8	2.3	1.6	2.6	15
	T	ft^2/day	154	1,200	515	423	394	380	8
	Storage	Unitless	0.007	0.028	0.014	0.007	0.0111	0.012	3
Meade Peak	K	ft/day	0.03	11.5	2.4	1.3	0.8	3.2	17
	T	ft^2/day	6	300	79	23	36	105	11
	Storage	Unitless	0.001	0.002	0.002	0.002	0.002	0.001	2
Wells Formation and Grandeur Tongue Alluvium	K	ft/day	0.08	118	11.4	2.0	1.6	28.8	19
	K	ft/day	0.1	18,086	1,913	41	61	4,994	13
	T	ft^2/day	0.0016	0.1884	0.0513	0.0074	0.0115	0.0035	6

The Enoch Valley Fault is conceptualized to be a permeable conduit that collects groundwater from the regional aquifer and directs it northwest, discharging at the Enoch Valley Sinkhole (Arcadis 2013). The Rasmussen Fault and Blackfoot Fault appear to act as barriers to groundwater flow in the regional system based on differences in groundwater levels on adjacent sides of the faults (Arcadis 2013). Monitoring wells MW-1W, MW-16W, and MW-17W are completed in the Grandeur Tongue, and OW-1W is completed in the Wells Formation; however, water levels in these wells that are about 30 to 220 feet higher than those observed along the Snowdrift Anticline axis in the Wells Regional Aquifer. The high water levels appear to be related to leakage through the Meade Peak (a leaky confining unit) and a low cross-bedding K in the Grandeur Tongue and the Upper Wells Formation.

Water levels in the Rex Chert (MW-4R, MW-5R, MW-11R, and MW-14R) and Dinwoody Formation (MW-10D) are 90 to 230 feet above the elevation of the regional water level. The Rex Chert and Dinwoody Formation are recharged on the southwest limb of the Snowdrift Anticline, where they crop out at the surface west of the proposed pit. Meteoric water that enters at the outcrop flows down-dip to the southwest becoming confined as it moves away from the recharge areas. Groundwater in confined portions of the aquifer may have artesian water levels that are above ground surface at some locations. Groundwater flow in the intermediate-flow systems is expected to be downdip towards the Enoch Valley Fault (**Figure 3.3-17**). The Enoch Valley Fault is interpreted to be a conduit that allows groundwater from the Rex Chert and Dinwoody Formation to move downward into the regional Wells Aquifer. In addition, there are minor faults present within the Study Area that could provide localized hydraulic connections between intermediate and regional flow systems.

Groundwater occurs in alluvium and colluvium on the southwest limb of the Snowdrift Anticline. The flow direction is typically southwest following topography toward Angus Creek. Water level data for unconsolidated deposits near the proposed overburden and ore storage facilities are available from baseline monitoring wells MW-6A, MW-8A, and MW-15A. Piezometers from the 2013 geotechnical investigation (STRATA 2013) provide additional information about the depth to water below the planned facilities (**Figure 3.3-17**). Monitoring well MW-9 is completed in alluvium that is buried beneath basalt near the south end of the proposed pit. Monitoring well

MW-19B straddles the basalt/alluvium contact, and water is observed in this well only seasonally (June through August). Water level data for unconsolidated deposits in the Study Area are summarized by area in **Table 3.3-17**.

Table 3.3-17 Summary of Depth to Water Measurements in Unconsolidated Deposits

Area	Monitoring Location	Type	Range of Measured Depths to Water (ft bgs)	
			Minimum	Maximum
North Growth Media Stockpile	GB-1	Piezometer	8.0	11.0
	GB-14	Piezometer	11.0	19.8
	GB-15	Piezometer	5.5	10.3
North Overburden Pile	MW-6A	Monitoring Well	50.22	57.07
	MM-15A	Monitoring Well	Dry	Dry
	GB-4	Piezometer	30.2	33.7
Optional Ore/Waste Stock Pile	GB-16	Piezometer	22.8	36.0
	GB-17	Piezometer	56.0	56.0
South-Main/South-South Overburden Piles	MW-8A	Monitoring Well	15.64	20.12
	GB-6	Piezometer	51.6	56.0
	GB-8	Piezometer	3.4	3.8
	GB-9	Piezometer	55.6	Dry
	GB-11	Piezometer	13.2	Dry
	GB-18	Piezometer	2.1	6.9
	GB-19	Piezometer	51.5	51.5
	GB-20	Piezometer	25.0	33.5
	GB-22	Piezometer	24.4	39.0
South External Overfill Area	GB-21	Piezometer	Dry	Dry
Alluvium Below Basalt	MW-9A	Monitoring Well	39.42	48.80
	MW-19B	Monitoring Well	51.02	51.51

3.3.2.3 Chemical Characteristics of Groundwater and Applicable Standards

3.3.2.3.1 Applicable Groundwater Standards

Idaho water quality standards for groundwater are contained in IDAPA 58.01.11. Aquifers in Idaho are classified as Sensitive Resources, General Resources, or Other Resources based on the vulnerability of the groundwater, existing and projected beneficial uses of the water, existing water quality, and social and economic considerations (IDAPA 58.01.11.150.02). Groundwater is spelled as two words (ground water) in IDAPA 58.01.11 and Idaho statistical Guidance Documents (IDEQ 2009, 2014b). This convention is observed for direct citations, but otherwise, groundwater is spelled as one word for consistency in this EIS. Groundwater classified as a Sensitive Resource receives the highest degree of protection, and applicable water quality standards for these resources may be stricter than those listed in IDAPA 58.01.11.200. Currently, the Rathdrum Prairie Aquifer, located 440 miles northwest of the Study Area, is the only aquifer listed as a Sensitive Resource in the State of Idaho (IDAPA 58.01.11.300.1). All other aquifers are categorized according to IDAPA 58.01.11.300.02, which defines a General Resource as:

> *"All aquifers or portions of aquifers where there are activities with the potential to degrade groundwater quality of the aquifer, unless otherwise listed in subsection 300.01 or 300.03. Once an activity with the potential to degrade the ground water quality of an uncategorized aquifer or portion of an aquifer is initiated, the uncategorized aquifer shall automatically become General Resource unless petitioned into the Sensitive Resource, or Other Resource category."*

No aquifers are currently listed as an Other Resource in the State of Idaho (IDAPA 58.01.11.300.03). Based on the aquifer classification system described in the Idaho Administrative Code, groundwater in the Study Area is classified as a General Resource and is subject to numerical standards contained in section 58.01.11.200 and modified in subsections 200.03, 301.02.a, and 401.1.

Subsection 200.03 states:

> *"If the natural background level of a constituent exceeds the standard in this section, the natural background level shall be used as the standard."*

Subsection 301.02 states:

> *"Activities with the potential to degrade General Resource aquifers shall be managed in a manner which maintains or improves existing ground water quality through the use of best management practices and best practical methods to the maximum extent practical except when a point of compliance is set pursuant to Section 401."*

Subsection 401.01 states:

> *"At the request of a mine operator, pursuant to this section, the Department [IDEQ] shall set a point of compliance, or points of compliance, at which the mine operator shall protect current and projected future beneficial uses of the ground water and meet the ground water quality standards as described in Section 200 or as allowed under Subsection 400.05. Degradation of ground water is allowed at a point of compliance if the mine operator implements the level of protection during mining activities appropriate for the aquifer category as specified in Table 1 of Subsection 150.02. If a request is not made, the mine operator must meet the ground water quality standards as described in Subsection 150.01 in ground water both within and beyond the mining area unless the Department establishes the point(s) of compliance consistent with Subsection 401.03."*

Finally, IDEQ's considerations for setting points of compliance are provided in subsection 401.3, which states:

> *The point(s) of compliance shall be set as close as possible to the boundary of the mining area, taking into consideration the relevant factors set forth in Subsections 401.03.a. through 401.03.h., but in no event shall the point(s) of compliance be within the boundary of the mining area. The mining area boundary means the outermost perimeter of the mining area (projected in the horizontal plane) as it would exist at the completion of the mining activity. The point(s) of compliance shall be set so that, outside the mining area boundary, there is no injury to current or projected future beneficial uses of ground water and there is no violation of water quality standards applicable to any interconnected surface waters. The Department's determination regarding the point(s) of compliance shall be based on an analysis and consideration of all relevant factors including, but not limited to:*
>
> *a. The hydrogeological characteristics of the mining area and surrounding land, including any dilution characteristics of the aquifer and any natural attenuation supported by site-specific data;*

b. *The concentration, volume, and physical and chemical characteristics of contaminants resulting from the mining activity, including the toxicity and persistence of the contaminants;*

c. *The quantity, quality, and direction of flow of ground water underlying the mining area;*

d. *The proximity and withdrawal rates of current ground water users;*

e. *A prediction of projected future beneficial uses;*

f. *The availability of alternative drinking water supplies;*

g. *The existing quality of the ground water, including other sources of contamination and their cumulative impacts on the ground water; and*

h. *Public health, safety, and welfare effects.*

Agrium has applied for and received a Points of Compliance determination from the IDEQ for the Rasmussen Valley Mine. Numerical groundwater quality standards for Idaho are presented in **Table 3.3-18** and are based on total concentration. For the Point of Compliance determination background levels or another method approved by IDEQ would be determined using methods described in Statistical Guidance for Determining Background Ground Water Quality and Degradation (IDEQ 2014b). For the point of compliance determination, background levels would be determined using methods described in Statistical Guidance for Determining Background Ground Water Quality and Degradation (IDEQ 2014b). For the EIS, baseline concentrations are calculated using summary statistics to provide a basis for determining impacts to groundwater.

Table 3.3-18 Idaho Groundwater Standards

Parameter	Idaho Groundwater Standards[1]	
	Primary	Secondary
Major Ions and Solution Parameters		
pH (s.u.)	–	6.5–8.5
Chloride (mg/L)	–	250
Fluoride (mg/L)	4	–
Sulfate (mg/L)	–	250
TDS (mg/L)	–	500
Nutrients		
Nitrate as nitrogen (mg/L)	10	–
Nitrite as nitrogen (mg/L)	1	
Nitrate/nitrite as nitrogen (mg/L)	10	–
Trace Metals (total concentrations)		
Aluminum (mg/L)	–	0.2
Antimony (mg/L)	0.006	–
Arsenic (mg/L)	0.05	–
Barium (mg/L)	2	–
Beryllium (mg/L)	0.004	
Cadmium (mg/L)	0.005	–
Chromium (mg/L)	0.1	–
Copper (mg/L)	1.3	–
Iron (mg/L)	–	0.3
Lead (mg/L)	0.015	–
Manganese (mg/L)	–	0.05
Mercury (mg/L)	0.002	–
Selenium (mg/L)	0.05	–

Table 3.3-18 Idaho Groundwater Standards

Parameter	Idaho Groundwater Standards[1]	
	Primary	**Secondary**
Silver (mg/L)	–	0.1
Thallium (mg/L)	0.002	–
Zinc (mg/L)	–	5

Notes:
– No standard
1 Standards are based on total (unfiltered) concentrations in groundwater.
Source: IDAPA 58.01.11

3.3.2.3.2 Baseline Groundwater Quality

Baseline monitoring of groundwater quality for the Study Area began in January 2011 and has been performed four times annually (April, June, August, and October) through the end of 2014. The baseline monitoring network includes four wells completed in alluvium, one well completed in the Dinwoody Formation, four wells completed in Rex Chert, and eight wells completed in the Wells Regional Aquifer. Samples from the monitoring wells were analyzed for 42 constituents including major ions, nutrients, and a suite of 21 metals (both total and dissolved concentrations). Complete documentation for baseline groundwater quality monitoring at Rasmussen Valley is presented in the Water Resources Baseline Characterization Report (Whetstone 2015b).

Baseline quality statistics for groundwater were calculated for 39 constituents using methods described in Statistical Guidance for Determining Background Ground Quality and Degradation (IDEQ 2014b, Whetstone 2015b) in order to inform an understanding of groundwater quality. The dataset for the statistical analysis extended through December 31, 2014 and included the full list of analyzed parameters with the exceptions of specific conductance, turbidity, and total suspended solids. These parameters do not represent specific chemical constituents and were omitted from the calculations. In addition, the statistical analysis used field-measured values of pH in place of laboratory measurements. The pH of groundwater samples can change rapidly after collection and may not be representative of the in situ pH of the aquifer(s). The suite of analytical parameters for the baseline monitoring program included both total (unfiltered) and dissolved (filtered) metals. The statistical analysis was performed using total metal concentrations to be consistent with Idaho groundwater quality standards (IDAPA 58.01.11).

<u>Groundwater Quality in Alluvium</u>

Baseline water quality statistics for groundwater in alluvium (**Table 3.3-19**) were calculated using data from monitoring wells MW-6A, MW-8A, and MW-9A. Monitoring well MW-15A was dry during all sampling events, and no data were available for the statistical analysis. Analytical results from the baseline monitoring program indicate that groundwater in alluvium is a moderate to well buffered calcium-bicarbonate type water with low to moderate concentrations of TDS (46 to 274 mg/L) and circum-neutral to alkaline pH (6.25 to 8.05 s.u.). Alluvial groundwater generally meets applicable water quality standards with the exceptions of pH, aluminum, iron, and manganese (MW-6A, MW-8A, and MW-9A). pH was outside of (below) the standard range of 6.5 to 8.5 s.u. for 2 percent of the samples and had a median value of 7.33 s.u. Aluminum exceeded the secondary groundwater standard of 0.2 mg/L in 18 percent of the samples and had a median concentration of 0.03 mg/L. Iron exceeded the secondary groundwater standard of 0.3 mg/L in 16 percent of the samples and had a median value of 0.09 mg/L. Manganese exceeded the secondary groundwater standard of 0.05 mg/L in 55 percent of the samples and had a median value of 0.094 mg/L.

Table 3.3-19 Baseline Water Quality Statistics for Groundwater in Alluvium

	Units	Ground-water Standard	Number of Samples	Percent Non-Detect	Min Value	Max Value	Median Value	Average Value	Standard Deviation
Major Ions and Solution Parameters									
pH[2]	s.u.	6.5-8.5	42	0.0	**6.25**	8.05	7.33	7.33	0.48
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		45	0.0	86.8	214	106	124	42.7
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		45	97.8	<2	<2.5	---	---	---
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		45	100.0	<2	<2.5	---	---	---
Alkalinity, Total (as $CaCO_3$)	mg/L		45	0.0	86.8	214	106	125	42.7
Total Dissolved Solids[2]	mg/L	500	45	0.0	46	274	170	168	52
Total Organic Carbon	mg/L		44	59.1	0.27	8.9	1	1.46	1.87
Calcium	mg/L		45	0.0	23.6	66.2	32.8	37.2	12.3
Magnesium	mg/L		45	0.0	4	13.4	6	7.0	2.9
Potassium	mg/L		45	2.2	0.48	1.7	0.76	0.80	0.30
Sodium	mg/L		44	0.0	4.1	14.3	7.3	6.9	1.9
Bromide	mg/L		44	43.2	<0.01	0.085	0.030	0.031	0.021
Chloride[2]	mg/L	250	44	2.3	2.5	8.1	5.7	5.2	1.9
Fluoride[1]	mg/L	4	44	4.5	0.1	0.25	0.2	0.20	0.03
Sulfate	mg/L	250	44	2.3	3.132	11.2	5.75	5.65	1.44
Nutrients									
Nitrate-Nitrite (as N) [1]	mg/L	10	44	27.3	<0.02	0.4	0.17	0.17	0.12
Ammonia (as N)	mg/L		45	22.2	<0.05	0.4	0.09	0.16	0.12
Phosphorus	mg/L		44	0.0	0.035	0.14	0.097	0.094	0.024
Trace Metals (total concentration)									
Aluminum[2]	mg/L	0.2	44	54.5	<0.03	**2.3**	0.03	0.19	0.42
Antimony[1]	mg/L	0.006	45	88.9	<0.0004	0.0010	---	---	---
Arsenic[1]	mg/L	0.05	45	40.0	<0.0005	0.0028	0.0008	0.0009	0.0005
Barium[1]	mg/L	2	45	0.0	0.024	0.128	0.055	0.070	0.031
Beryllium[1]	mg/L	0.004	37	97.3	<0.0001	0.00023	---	---	---
Boron	mg/L		45	17.8	<0.01	0.023	0.014	0.010	0.004
Cadmium[1]	mg/L	0.005	45	84.4	<0.0001	0.0005	---	---	---
Chromium[1]	mg/L	0.1	44	59.1	<0.0005	0.006	0.0005	0.0006	0.0010
Copper[1]	mg/L	1.3	44	72.7	<0.0005	0.0057	0.0005	0.0006	0.0010
Iron[2]	mg/L	0.3	44	27.3	<0.02	**3.8**	0.09	0.27	0.61
Lead[1]	mg/L	0.015	44	68.2	<0.0001	0.0021	0.0001	0.0002	0.004
Manganese[2]	mg/L	0.05	45	4.4	<0.0005	**0.54**	**0.094**	**0.121**	0.127
Mercury[1]	mg/L	0.002	45	100.0	<0.0002	<0.0002	---	---	---
Molybdenum	mg/L		45	82.2	<0.01	<0.02	---	---	---
Nickel	mg/L		45	100.0	<0.01	<0.02	---	---	---
Selenium[1]	mg/L	0.05	44	34.1	<0.0001	0.0014	0.0005	0.0005	0.0003
Silver[2]	mg/L	0.1	45	97.8	<0.00005	0.00013	---	---	---
Thallium[1]	mg/L	0.002	45	91.1	<0.0001	0.00033	---	---	---
Uranium	mg/L		44	34.1	<0.0001	0.0021	0.0002	0.0005	0.0005
Vanadium	mg/L		44	40.9	<0.0002	<0.01	0.0026	0.0019	0.0017
Zinc[2]	mg/L	5	44	79.5	<0.0028	0.028	0.0028	0.0031	0.0060

Notes:

1 Idaho primary groundwater standard

2 Idaho secondary groundwater standard

s.u. standard units

< Indicates that the value was below the analytical detection limit. Applies only to laboratory determined minimum and maximum values. Statistically determined values for median, average, and standard deviation are not marked as being below the detection limit

Bolded values are equal to or exceed Idaho groundwater quality standards in IDAPA 58.01.11. 200

Samples with elevated aluminum concentrations typically have elevated turbidity, suggesting that the aluminum is associated with suspended clay sediment

Statistics for median, average, and standard deviation were not calculated for datasets containing more than 80 percent non-detect values

Groundwater Quality in the Dinwoody Formation

Baseline water quality statistics for groundwater in the Dinwoody Formation (**Table 3.3-20**) were calculated using data from monitoring well MW-10D. Analytical results from the baseline monitoring program indicate that groundwater in the Dinwoody Formation is a well buffered calcium-bicarbonate to calcium-sulfate type water with moderate concentrations of TDS (374 to 496 mg/L) and circum-neutral pH (7.14 to 7.51 s.u.). Groundwater in the Dinwoody Formation generally meets applicable water quality standards with the exceptions of iron and manganese. Iron was equal to or exceeded the secondary groundwater standard of 0.3 mg/L in 64 percent of the samples and had a median value of 0.30 mg/L. Manganese exceeded the secondary groundwater standard of 0.05 mg/L in 100 percent of the samples and had a median value of 0.285 mg/L.

Table 3.3-20 Baseline Water Quality Statistics for Groundwater in the Dinwoody Formation

	Units	Ground-water Standard	Number of Samples	Percent Non-Detect	Min Value	Max Value	Median Value	Average Value	Standard Deviation
Major Ions and Solution Parameters									
pH[2]	s.u.	6.5-8.5	12	0.0	7.14	7.51	7.34	7.32	0.11
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		11	0.0	205	222	212	213	5.9
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		12	100.0	<2.5	<2.5	---	---	---
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		12	100.0	<2.5	<2.5	---	---	---
Alkalinity, Total (as $CaCO_3$)	mg/L		11	0.0	205	222	212	213	5.9
Total Dissolved Solids[2]	mg/L	500	12	0.0	374	496	405	416	38.3
Total Organic Carbon	mg/L		12	91.7	<0.72	1.1	---	---	---
Calcium	mg/L		12	0.0	67.8	80.7	73.9	74.4	4.2
Magnesium	mg/L		12	0.0	30.6	36.8	33.3	33.5	1.9
Potassium	mg/L		11	0.0	0.88	1.2	0.99	1.02	0.11
Sodium	mg/L		11	0.0	5.7	9.7	6.5	7.1	1.3
Bromide	mg/L		12	66.7	<0.01	0.044	0.01	0.016	0.012
Chloride[2]	mg/L	250	12	0.0	7.4	9.1	7.9	8.0	0.47
Fluoride[1]	mg/L	4	11	0.0	0.19	0.33	0.22	0.23	0.04
Sulfate[2]	mg/L	250	12	0.0	91.5	185	114	126.2	31.6
Nutrients									
Nitrate-Nitrite (as N) [1]	mg/L	10	12	83.3	<0.02	0.052	---	---	---
Ammonia (as N)	mg/L		11	0.0	0.22	0.43	0.28	0.29	0.05
Phosphorus	mg/L		11	36.4	<0.01	0.044	0.013	0.016	0.009
Trace Metals (total concentration)									
Aluminum[2]	mg/L	0.2	12	66.7	<0.03	0.06	0.03	0.04	0.01
Antimony[1]	mg/L	0.006	12	100.0	<0.0004	<0.0004	---	---	---
Arsenic[1]	mg/L	0.05	12	0.0	0.0054	0.013	0.0072	0.008	0.0020
Barium[1]	mg/L	2	12	0.0	0.019	0.043	0.021	0.024	0.007
Beryllium[1]	mg/L	0.004	12	100.0	<0.0001	<0.0001	---	---	---
Boron	mg/L		12	0.0	0.017	0.029	0.026	0.024	0.004
Cadmium[1]	mg/L	0.005	12	100.0	<0.0001	<0.0001	---	---	---
Chromium[1]	mg/L	0.1	12	83.3	<0.0005	0.0008	---	---	---
Copper[1]	mg/L	1.3	12	100.0	<0.0005	<0.0005	---	---	---
Iron[2]	mg/L	0.3	11	0.0	0.18	**0.65**	**0.30**	**0.32**	0.12
Lead[1]	mg/L	0.015	12	100.0	<0.0001	<0.0001	---	---	---
Manganese[2]	mg/L	0.05	12	0.0	**0.24**	**0.41**	**0.285**	**0.298**	0.047
Mercury[1]	mg/L	0.002	12	100.0	<0.0002	<0.0002	---	---	---
Molybdenum	mg/L		12	100.0	<0.01	<0.01	---	---	---
Nickel	mg/L		12	100.0	<0.01	<0.01	---	---	---
Selenium[1]	mg/L	0.05	12	91.7	<0.0001	0.0001	---	---	---
Silver[2]	mg/L	0.1	12	91.7	<0.00005	0.00007	---	---	---
Thallium[1]	mg/L	0.002	12	91.7	<0.0001	0.0005	---	---	---
Uranium	mg/L		12	0.0	0.0008	0.0021	0.0011	0.0010	0.0004

Table 3.3-20 Baseline Water Quality Statistics for Groundwater in the Dinwoody Formation

	Units	Ground-water Standard	Number of Samples	Percent Non-Detect	Min Value	Max Value	Median Value	Average Value	Standard Deviation
Vanadium	mg/L		12	100.0	<0.0002	<0.0002	---	---	---
Zinc[2]	mg/L	5	12	100.0	<0.0028	<0.0028	---	---	---

Notes:

1 Idaho primary groundwater standard

2 Idaho secondary groundwater standard

s.u. standard units

< Indicates that the value was below the analytical detection limit. Applies only to laboratory determined minimum and maximum values. Statistically determined values for 25th percentile, median, and 75th percentile are not marked as being below the detection limit

Bolded values are equal to or exceed Idaho groundwater quality standards in IDAPA 58.01.11. 200.

Statistics for median, average, and standard deviation were not calculated for datasets containing more than 80 percent non-detect values

Groundwater Quality in the Rex Chert

Baseline water quality statistics for groundwater in the Rex Chert (**Table 3.3-21**) were calculated using data from monitoring wells MW-4R, MW-5R, MW-11R, and MW-14R. Analytical results from the baseline monitoring program indicate that groundwater in the Rex Chert is a well buffered calcium-bicarbonate type water with low to weakly elevated concentrations of TDS (96 to 418 mg/L) and circum-neutral to weakly alkaline pH (6.77 to 7.95 s.u.). Groundwater in the Rex Chert generally meets applicable water quality standards with the exceptions of iron (MW-4R, MW-5R, MW-11R, and MW-14R), and manganese (MW-4R, MW-5R, MW-11R, and MW-14R). Iron was equal to or exceeded the secondary groundwater standard of 0.3 mg/L in 61 percent of the samples and had a median value of 0.37 mg/L. Manganese exceeded the secondary groundwater standard of 0.05 mg/L in 97 percent of the samples and had a median value of 0.122 mg/L.

Table 3.3-21 Baseline Water Quality Statistics for Groundwater in the Rex Chert

	Units	Ground-water Standard	Number of Samples	Percent Non-Detect	Min Value	Max Value	Median Value	Average Value	Standard Deviation
Major Ions and Solution Parameters									
pH[2]	s.u.	6.5-8.5	55	0.0	6.77	7.95	7.21	7.20	0.20
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		58	0.0	125	289	226	216	49.6
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		58	98.3	<2	3	---	---	---
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		58	100.0	<2	<2.5	---	---	---
Alkalinity, Total (as $CaCO_3$)	mg/L		58	0.0	125	289	226	216	49.7
Total Dissolved Solids[2]	mg/L	500	57	0.0	96	418	264	276	62.2
Total Organic Carbon	mg/L		58	36.2	0.53	12	2.25	3.06	2.97
Calcium	mg/L		58	0.0	37.5	82.4	49.9	55.0	14.7
Magnesium	mg/L		58	0.0	13.3	33.2	19.3	20.3	5.9
Potassium	mg/L		57	3.5	0.4	1.9	0.61	0.79	0.40
Sodium	mg/L		57	0.0	4.9	59.6	8.6	15.3	13.8
Bromide	mg/L		58	46.6	<0.01	0.089	0.023	0.031	0.024
Chloride[2]	mg/L	250	58	0.0	2.3	14.5	6.1	6.4	3.5
Fluoride[1]	mg/L	4	58	0.0	0.17	1.2	0.50	0.52	0.33
Sulfate[2]	mg/L	250	57	0.0	19	80.9	25.4	26.7	8.7
Nutrients									
Nitrate-Nitrite (as N)[1]	mg/L	10	56	60.7	<0.02	0.44	0.02	0.03	0.07
Ammonia (as N)	mg/L		58	22.4	<0.05	1.2	0.10	0.25	0.33
Phosphorus	mg/L		58	6.9	<0.01	0.69	0.04	0.15	0.20
Trace Metals (total concentration)									
Aluminum[2]	mg/L	0.2	57	64.9	<0.03	0.19	0.03	0.03	0.04
Antimony[1]	mg/L	0.006	58	94.8	<0.0004	0.001	---	---	---
Arsenic[1]	mg/L	0.05	57	50.9	<0.0005	0.0075	0.0005	0.0014	0.0014

Table 3.3-21 Baseline Water Quality Statistics for Groundwater in the Rex Chert

	Units	Ground-water Standard	Number of Samples	Percent Non-Detect	Min Value	Max Value	Median Value	Average Value	Standard Deviation
Barium[1]	mg/L	2	58	0.0	0.006	0.2	0.056	0.050	0.044
Beryllium[1]	mg/L	0.004	47	100.0	<0.0001	<0.0001	---	---	---
Boron	mg/L		58	8.6	<0.01	0.04	0.02	0.02	0.01
Cadmium[1]	mg/L	0.005	58	96.6	<0.0001	0.00019	---	---	---
Chromium[1]	mg/L	0.1	58	46.6	<0.0005	0.0031	0.0005	0.0009	0.0006
Copper[1]	mg/L	1.3	57	77.2	<0.0005	0.0084	0.0005	0.0005	0.0012
Iron[2]	mg/L	0.3	57	0.0	0.048	**3.5**	**0.37**	**0.75**	0.90
Lead[1]	mg/L	0.015	58	89.7	<0.0001	0.0010	---	---	---
Manganese[2]	mg/L	0.05	58	0.0	0.033	**0.73**	**0.122**	**0.230**	0.187
Mercury[1]	mg/L	0.002	58	100.0	<0.0002	<0.0004	---	---	---
Molybdenum	mg/L		58	44.8	<0.01	0.05	0.02	0.02	0.01
Nickel	mg/L		57	68.4	<0.01	0.08	0.01	0.01	0.01
Selenium[1]	mg/L	0.05	57	82.5	<0.0001	0.0009	---	---	---
Silver[2]	mg/L	0.1	58	96.6	<0.00005	0.00007	---	---	---
Thallium[1]	mg/L	0.002	58	94.8	<0.0001	0.00034	---	---	---
Uranium	mg/L		57	5.3	<0.0001	0.002	0.0006	0.0007	0.0005
Vanadium	mg/L		58	74.1	<0.0002	0.01	0.0002	0.0003	0.0008
Zinc[2]	mg/L	5	57	61.4	<0.0028	0.33	0.0039	0.0148	0.0533

Notes:
1 Idaho primary groundwater standard
2 Idaho secondary groundwater standard
s.u. standard units
< Indicates that the value was below the analytical detection limit. Applies only to laboratory determined minimum and maximum values. Statistically determined values for median, average, and standard deviation are not marked as being below the detection limit

Bolded values are equal to or exceed Idaho groundwater quality standards in IDAPA 58.01.11. 200.

Statistics for median, average, and standard deviation were not calculated for datasets containing more than 80 percent non-detect values

Groundwater Quality in the Wells Regional Aquifer

Baseline statistics for groundwater in the Wells Regional Aquifer (**Table 3.3-22**) were calculated using data from monitoring wells MW-1W, MW-12W, MW-13W, MW-16W, MW17W, and OW-1W. Analyses from monitoring wells MW-2W and MW-3W were omitted from the statistical analyses because of differences in the groundwater chemistry at these locations compared to other wells in the Wells Regional Aquifer. Groundwater monitored by MW-2W has an approximate temperature of 32 degrees Celsius (°C) and is classified as a low-temperature geothermal water (i.e., above 29.4 °C [IDAPA 37.03.09]). Groundwater temperatures in other wells completed in the regional aquifer range from 10 to 25°C, with most falling below 20°C. MW-2W also exhibits elevated concentrations of TDS (834 to 1,020 mg/L), calcium (114 to 134 mg/L), magnesium (35.3 to 42.7 mg/L), potassium (6.3 to 6.8 mg/L), sodium (108 to 186 mg/L), chloride (149 to 172 mg/L), fluoride (1.4 to 1.7 mg/L), sulfate (340 to 404 mg/L), boron (0.038 to 0.086 mg/L), and uranium (0.00094 to 0.0086 mg/L) compared to other wells (Whetstone 2015b). Differences in the temperature and chemistry of groundwater from MW-2W are interpreted to be caused by localized fracturing that allows deeper geothermal water to circulate upward in the area of MW-2W. Analyses for MW-3W indicate that groundwater from the well has elevated selenium concentrations (0.0012 to 0.0035 mg/L) compared to groundwater from other wells in the Wells Regional Aquifer (less than 0.0001 to 0.0009 mg/L). Similar to MW-2W, the differences in chemistry at MW-3W are interpreted to be related to localized conditions and are not considered to be representative of the baseline chemistry of the wider Wells Regional Aquifer.

Table 3.3-22 Baseline Water Quality Statistics for Groundwater in the Regional Wells Aquifer

	Units	Ground-water Standard	Number of Samples	Percent Non-Detect	Min Value	Max Value	Median Value	Average Value	Standard Deviation
Major Ions and Solution Parameters									
pH[2]	s.u.	6.5-8.5	70	0.0	6.98	8.89	7.40	7.50	0.35
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		72	0.0	139	292	209	215	26.8
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		72	94.4	<2	17	---	---	---
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		72	100.0	<2	<2.5	---	---	---
Alkalinity, Total (as $CaCO_3$)	mg/L		72	0.0	155	292	209	215	25.5
Total Dissolved Solids[2]	mg/L	500	71	0.0	92	316	268	261	39.2
Total Organic Carbon	mg/L		71	52.1	0.31	5.6	1	1.4	1.3
Calcium	mg/L		72	0.0	27.4	81.6	55.5	56.3	7.97
Magnesium	mg/L		72	0.0	13.5	27.3	18.6	19.0	3.1
Potassium	mg/L		71	0.0	0.7	4.7	1.2	1.6	0.9
Sodium	mg/L		72	0.0	4.2	42.1	8.8	12.3	9.4
Bromide	mg/L		72	48.6	0.01	0.083	0.019	0.024	0.018
Chloride[2]	mg/L	250	72	0.0	2.3	13.7	3.8	4.9	3.2
Fluoride[1]	mg/L	4	72	0.0	0.11	0.86	0.67	0.57	0.24
Sulfate[2]	mg/L	250	72	0.0	6.9	51	21.4	22.4	9.6
Nutrients									
Nitrate-Nitrite (as N)[1]	mg/L	10	71	80.3	<0.02	0.19	---	---	---
Ammonia (as N)	mg/L		72	15.3	<0.05	0.33	0.11	0.13	0.07
Phosphorus	mg/L		71	54.9	<0.01	0.066	0.010	0.013	0.013
Trace Metals (total concentration)									
Aluminum[2]	mg/L	0.2	71	67.6	<0.03	**0.54**	0.03	0.04	0.08
Antimony[1]	mg/L	0.006	71	66.2	<0.0004	<0.0067	0.0004	0.0005	0.0010
Arsenic[1]	mg/L	0.05	71	22.5	<0.0005	0.018	0.0016	0.0033	0.0036
Barium[1]	mg/L	2	72	0.0	0.011	0.175	0.070	0.070	0.038
Beryllium[1]	mg/L	0.004	67	98.5	<0.0001	0.00072	---	---	---
Boron	mg/L		72	9.7	<0.01	0.03	0.02	0.02	0.005
Cadmium[1]	mg/L	0.005	71	80.3	<0.0001	0.0017	---	---	---
Chromium[1]	mg/L	0.1	72	52.8	<0.0005	0.0047	0.0005	0.0007	0.0009
Copper[1]	mg/L	1.3	71	69.0	<0.0005	0.0034	0.0005	0.0005	0.0007
Iron[2]	mg/L	0.3	71	2.8	<0.02	**4.5**	0.28	**0.61**	0.84
Lead[1]	mg/L	0.015	71	88.7	<0.0001	0.00036	---	---	---
Manganese[2]	mg/L	0.05	71	0.0	0.02	**0.94**	**0.10**	**0.15**	0.18
Mercury[1]	mg/L	0.002	72	100.0	<0.0002	<0.0002	---	---	---
Molybdenum	mg/L		71	28.2	<0.01	0.11	0.02	0.02	0.02
Nickel	mg/L		71	69.0	<0.01	0.044	0.010	0.009	0.007
Selenium[1]	mg/L	0.05	71	80.3	<0.0001	0.0009	---	---	---
Silver[2]	mg/L	0.1	72	97.2	<0.00005	0.0001	---	---	---
Thallium[1]	mg/L	0.002	71	70.4	<0.0001	0.00068	0.0001	0.0001	0.0001
Uranium	mg/L		71	16.9	<0.0001	0.0028	0.0006	0.0009	0.0008
Vanadium	mg/L		71	46.5	<0.0002	0.008	0.0003	0.0010	0.0016
Zinc[2]	mg/L	5	71	43.7	<0.0028	0.19	0.0059	0.0285	0.0437

Notes:

1 Idaho primary groundwater standard

2 Idaho secondary groundwater standard

s.u. Standard units

< Indicates that the value was below the analytical detection limit. Applies only to laboratory determined minimum and maximum values. Statistically determined values for median, average, and standard deviation are not marked as being below the detection limit

Bolded values are equal to or exceed Idaho groundwater quality standards in IDAPA 58.01.11. 200.

Statistics for median, average, and standard deviation were not calculated for datasets containing more than 80 percent non-detect values

Excluding monitoring wells MW-2W and MW-3W, analytical data from the baseline monitoring program indicate that groundwater in the Wells Regional Aquifer is a well buffered calcium-bicarbonate type water with moderate concentrations of total dissolved solids (92 to 316 mg/L) and circum-neutral to alkaline pH (6.98 to 8.89 s.u.). Groundwater in the wells summarized in **Table 3.3-22** generally met applicable water quality standards with the exceptions of aluminum (MW-1W, MW-13W, MW-16W, and OW-1W), iron (MW-1W, MW-12W, MW-16W, MW17W, and OW-1W), and manganese (MW-1W, MW-12W, MW-13W, MW-16W, MW17W, and OW-1W).

Four percent of the results in **Table 3.3-22** were equal to or exceeded the secondary groundwater standard for aluminum (0.2 mg/L). Forty-six percent of the results were equal to or exceeded the secondary groundwater standard for iron (0.3 mg/L). Sixty-three percent of the results exceeded the secondary groundwater standard for manganese (0.05 mg/L).

3.4 SOILS

The quality and productivity of Study Area soils are critical components of ecosystem and watershed health. Good soil productivity and quality help prevent erosion and soil loss, maintain fine litter and coarse woody debris, help maintain stable vegetation communities, and promote important soil characteristics such as bulk density (USFS 2003). These soil functions support other components of the ecosystem, such as food and other biomass production (e.g., wildlife and livestock forage), biological and microbiological habitat, and other components. Additionally, soils salvaged from mines and associated areas are important reclamation materials (i.e., GM). These materials can be used to return reclaimed mined lands to conditions favorable for pre-mining land uses, including the aforementioned soil functions (U.S. Department of Agriculture [USDA] 2009).

To evaluate baseline soil conditions and GM suitability, Order 2 soil surveys were completed in 2011 and 2014 for the Study Area (AECOM 2012, 2015). Order 2 soil surveys are generally completed at a 1:10,000 or 1:20,000 scale and involve aerial photograph interpretation as well as collecting data by walking transects of the survey area. Soil samples were collected during the 2011 survey to evaluate agronomic properties and soil suitability properties. Agronomic properties are those properties of soil that contribute to plant growth and field crop production. Concentrations of total metals and plant-available selenium in the soil profile were also evaluated because of concerns about environmental mobility of these constituents if the soils are disturbed. The 2014 survey extended the 2011 survey into adjacent contiguous areas potentially to be disturbed by proposed alternatives.

Soil descriptions and data presented in this section are based on the two AECOM studies, except where noted otherwise. **Figure 3.4-1** illustrates a compilation of soil survey data points, including pedons, transect points, and reconnaissance points from the initial and supplemental soil surveys.

3.4.1 Environmental Setting

Existing soils in the Study Area are largely undisturbed except where past mineral exploration has created local disturbances including roads, mineral exploration and environmental drilling pads, and trenches. Some areas have been previously reclaimed with regrading, reseeding, and placement of straw mats. Study Area soils have not been interpreted by the USDA with respect to their status as prime farmland. However, soils with climatic, elevation, topographic, and parent material characteristics similar to those which dominate the Study Area are likely not prime farmland elsewhere in Caribou County (NRCS 2015). Therefore, there is a low likelihood that soils with prime farmland characteristics are present within the Study Area.

3.4.2 Study Area Soils

3.4.2.1 Soil Map Unit Characteristics

Soil map units delineated in the Order 2 soil survey and supplemental survey are illustrated on **Figure 3.4-2** and summarized in **Table 3.4-1**. Eight soil map units, composed of 13 different soil series, were developed for the Order 2 soil survey, as well as map unit DTL, which represents previously disturbed and reclaimed land, and map unit RXO, which represents rock outcrop. Complete soil profile descriptions, detailed laboratory analytical results, and soil survey field data are presented in AECOM (2012, 2015). Most of the soils in the Study Area are very deep and well drained. Texturally, most soils are fine-loamy, fine-silty, or loamy-skeletal. Taxonomic classifications of the soil series are presented in **Table 3.4-2**.

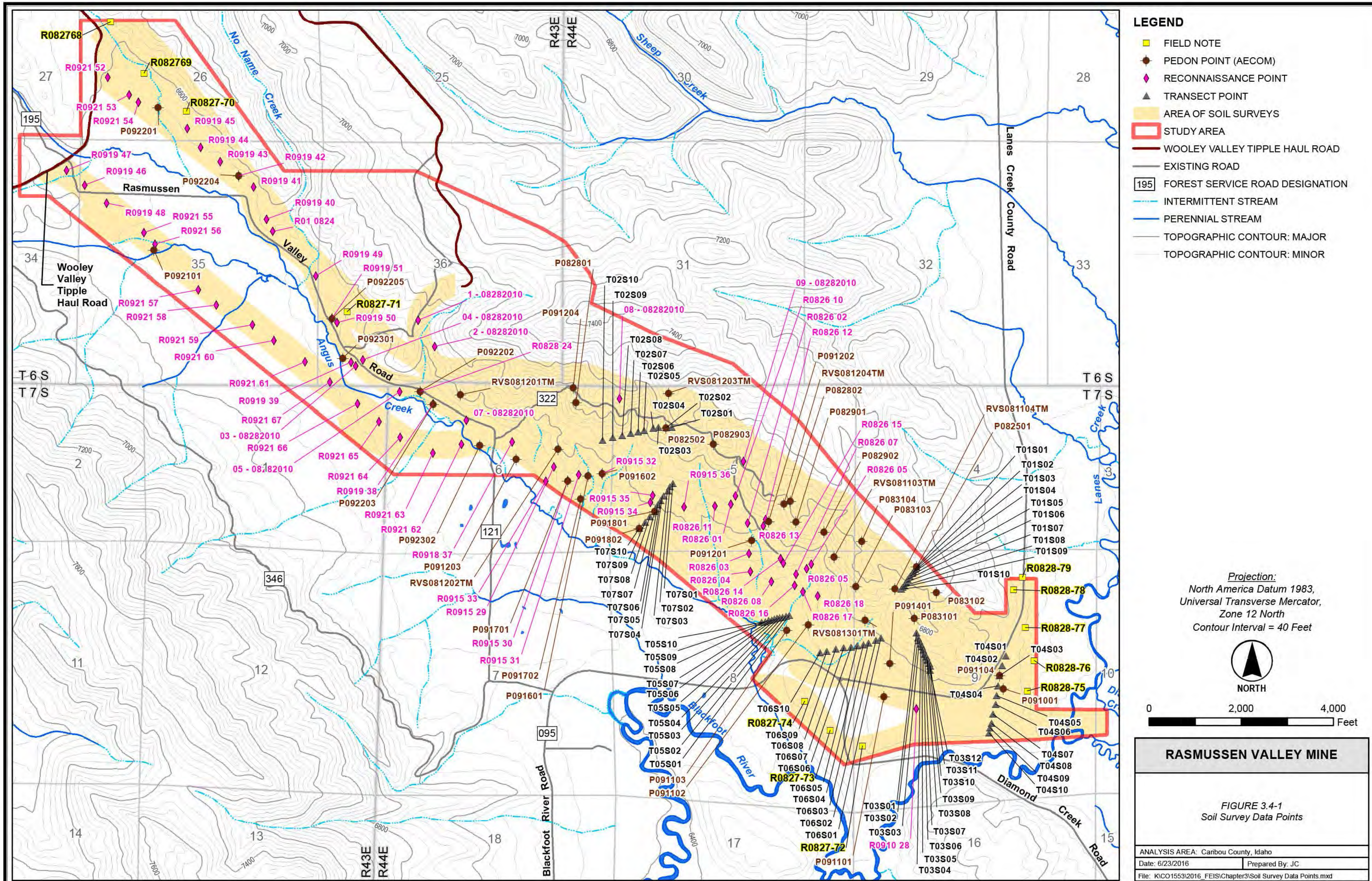
3.4.2.2 Trace Element Results

Trace elements are important soil nutrients, but can also limit the use of a soil as GM if plants are able to uptake high concentrations of potentially harmful elements. Uptake of trace elements by plants depends on the species and other factors, such as soil pH. The Caribou National Forest (CNF) Revised Forest Plan (RFP; USFS 2003) and Pocatello Field Office (PFO) Approved Resource Management Plan (ARMP; BLM 2012a) do not establish reclamation suitability criteria for trace element concentrations in soils to be used for reclamation.

The Order 2 soil survey (AECOM 2012) analyzed the total concentrations of many trace elements in Study Area soils. All soil samples were also analyzed for plant-available selenium (i.e., the amount of selenium that may be incorporated into a plant through its root system). In addition, composite samples of GM and alluvium/colluvium were analyzed for plant-available selenium as part of the investigation of potential cap-and-cover materials (BC 2015a). The maximum plant-available selenium reported was 0.03 ppm from the 30- to 58-inch layer of the Chubbflat soil (AECOM 2012). No soils or composite samples of GM and alluvium/colluvium proposed for use in reclamation are considered unsuitable because of selenium concentrations.

3.4.3 Soil Suitability and Quantity

Soil intended for use as GM must exhibit suitable chemical and physical characteristics for successful reclamation. Soil data collected during the Order 2 soil survey and supplemental soil survey reported by AECOM (2012, 2015) were evaluated for suitability as reclamation materials by Arcadis (2015d) per the USDA NRCS “Construction Materials; Reclamation” rule (NRCS 2014b), as modified by USFS (USFS 2014b). This rule supersedes the Topsoil Suitability Rating Guidelines and interpretations presented in the Soil Survey Report (AECOM 2012). Detailed interpretations, and the approach determined by BLM and USFS to provide the most appropriate and useful assessments of salvageable GM, are presented in Arcadis (2015d). Criteria used to rate soils for suitability as GM included cobble content, stone content, clay content, sand content, available water capacity (droughtiness), depth to bedrock, depth to cemented pan, organic material content, carbonate content, sodium content, salinity, alkalinity, acidity, and susceptibility to wind and water erosion. In addition, a site-specific criterion for soils saturated by water was applied (Arcadis 2015e). Each of these criteria has the potential to limit a soil’s usefulness as GM. This interpretation provides a classification of soils as either “good,” “fair,” or “poor” potential GM. Depth to bedrock and depth to cemented pan were also used to evaluate quantity of GM available. As described above, the concentrations of selenium and other trace metals found in Study Area soils do not limit their use as GM. A summary of suitability criteria evaluated by Arcadis (2015d) is provided in **Table 3.4-3**.



LEGEND
FIELD NOTE
PEDON POINT (AECOM)
RECONNAISSANCE POINT
TRANSECT POINT
AREA OF SOIL SURVEYS
STUDY AREA
WOOLEY VALLEY TIPPLE HAUL ROAD
EXISTING ROAD
195 FOREST SERVICE ROAD DESIGNATION
INTERMITTENT STREAM
PERENNIAL STREAM
TOPOGRAPHIC CONTOUR: MAJOR
TOPOGRAPHIC CONTOUR: MINOR
Projection:
North America Datum 1983,
Universal Transverse Mercator,
Zone 12 North
Contour Interval = 40 Feet
NORTH
0
2,000
4,000
Feet
RASMUSSEN VALLEY MINE
FIGURE 3.4-1
Soil Survey Data Points
ANALYSIS AREA: Caribou County, Idaho
Date: 6/23/2016
Prepared By: JC
File: K:\CO1553\2016_FEIS\Chapter3\Soil Survey Data Points.mxd
Wooley Valley Tipple Haul Road
Rasmussen Valley Road
Angus Creek
No Name Creek
Sheep Creek
Lanes Creek County Road
Blackfoot River Road
Blackfoot River
Diamond Creek Road
R43E
R44E
T6S
T7S

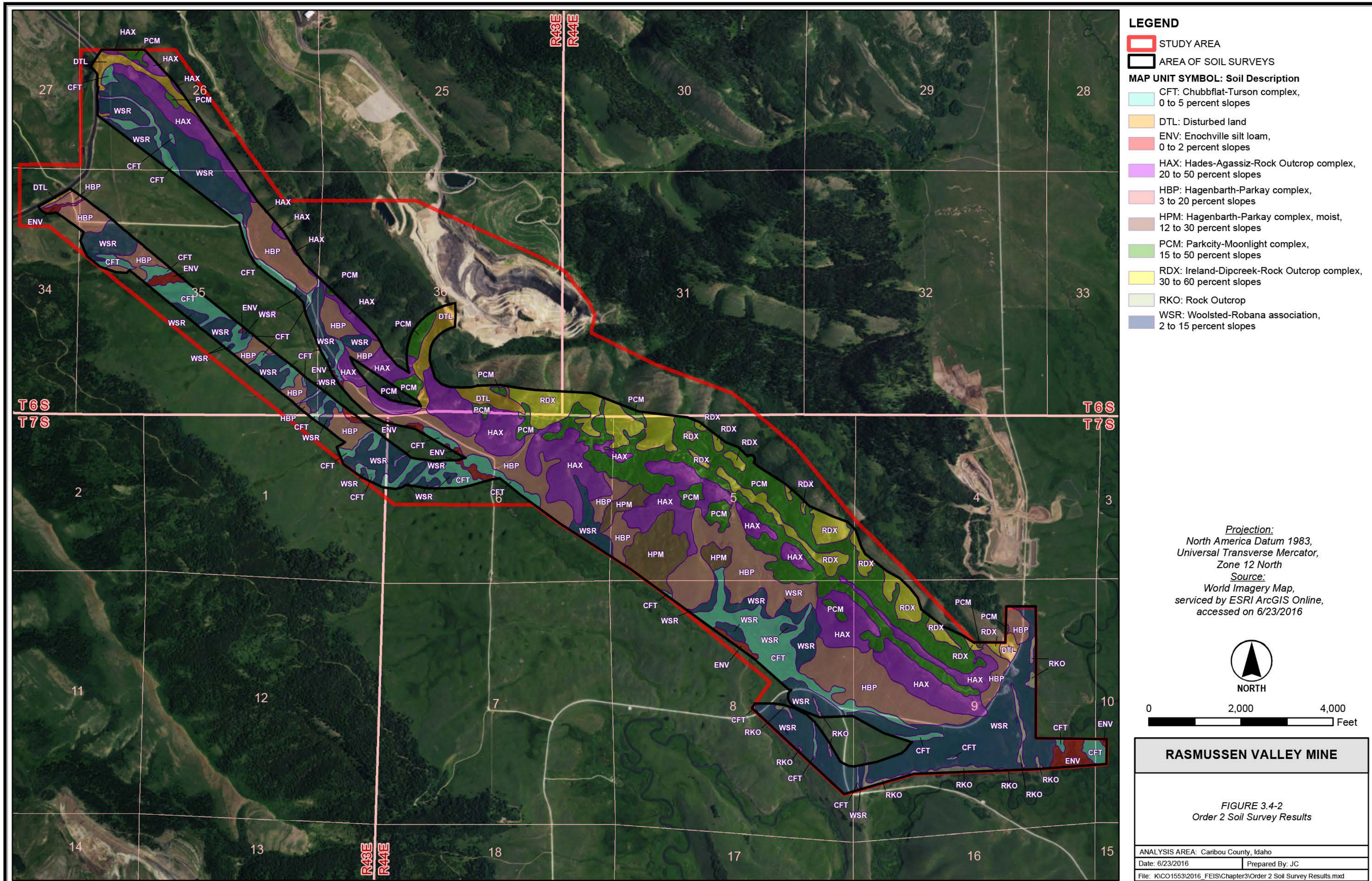


FIGURE 3.4-2
Order 2 Soil Survey Results

Table 3.4-1 Study Area Soil Distribution

Map Unit Symbol	Map Unit Name	Acreage: Acres	Acreage: % of Study Area	Soil component: Name	Soil component: % of unit
CFT	Chubbflat-Turson complex, 0 to 5 percent slopes	154.8	10.1	Chubbflat	85
				Turson	10
				Inclusion-Enochville	2
				Inclusion-Robana	2
				Inclusion-Parkay	1
DTL	Disturbed land	43.3	2.8	Disturbed land	100
ENV	Enochville silt loam, 0 to 1 percent slopes	24.7	1.6	Enochville	95
				Inclusion-Chubbflat	3
				Inclusion-Robana	1
				Inclusion-Turson	1
HAX	Hades-Agassiz-Rock Outcrop complex, 20 to 50 percent slopes	271.7	17.7	Hades	55
				Agassiz	25
				Rock Outcrop	10
				Inclusion-Loamy-skeletal soils	5
				Inclusion-Moderately deep soils	5
HBP	Hagenbarth-Parkay complex, 3 to 20 percent slopes	298.4	19.5	Hagenbarth	60
				Parkay	30
				Inclusion-Robana	3
				Inclusion-Woolsted	3
				Inclusion-Clayey soils	3
				Inclusion-Rock outcrop	1
HPM	Hagenbarth-Parkay complex, moist, 12 to 30 percent slopes	48.5	3.2	Hagenbarth	50
				Parkay	35
				Inclusion-Clayey soils	7
				Inclusion-Wet soils	7
				Inclusion-Ponds	1
PCM	Parkcity-Moonlight complex, 15 to 50 percent slopes	224.0	14.6	Parkcity	70
				Moonlight	15
				Inclusion-Fine-loamy soils	5
				Inclusion-Parkay	4
				Inclusion-Hagenbarth	4
				Inclusion-Rock outcrop	2
RDX	Ireland-Dipcreek-Rock Outcrop complex, 30 to 60 percent slopes	108.5	7.1	Ireland	45
				Dipcreek	30
				Rock Outcrop	15
				Inclusion-Xerorthents	5
				Inclusion-Deep soils	3
				Inclusion-Parkcity	2
RKO	Rock Outcrop	15.0	1.0	Rock Outcrop	100
WSR	Woolsted-Robana association, 2 to 15 percent slopes	343.3	22.4	Woolsted	50
				Robana	40
				Inclusion-Hagenbarth	5
				Inclusion-Chubbflat	5
Total Acres in Study Area		**1,532.2**	**100.0**		

Notes:
Inclusions are soil components or miscellaneous areas that are not identified in the name of the map unit and are often too small to be delineated separately.
Source: AECOM 2012, 2015

Table 3.4-2 Classification of Soils

Soil Series	Taxonomic class
Agassiz	Loamy-skeletal, mixed, superactive, frigid Lithic Haploxerolls
Chubbflat	Fine-silty, mixed, superactive Aquic Cumulic Haplocryolls
Dipcreek[1]	Loamy-skeletal, mixed, superactive, frigid Lithic Haploxerolls
Enochville	Fine-silty, mixed, superactive Cumulic Cryaquolls
Hades[2]	Fine-loamy, mixed, superactive, frigid Pachic Argixerolls
Hagenbarth	Fine-loamy, mixed, superactive Pachic Argicryolls
Ireland	Loamy-skeletal, mixed, superactive, frigid Calcic Haploxerolls
Moonlight	Coarse-loamy, mixed, superactive Pachic Haplocryolls
Parkay	Loamy-skeletal, mixed, superactive Pachic Argicryolls
Parkcity	Loamy-skeletal, mixed, superactive Pachic Haplocryolls
Robana	Fine-silty, mixed, superactive Pachic Argicryolls
Turson	Fine-loamy over sandy or sandy-skeletal, mixed, superactive Oxyaquic Haplocryolls
Woolsted	Fine-silty, mixed, superactive Xeric Haplocryolls

Notes:

1 This soil is a taxadjunct[3] to the named series in that the soil mapped in the Study Area has calcium carbonate accumulations or finely disseminated calcium carbonate in the soil profile.

2 This soil is a taxadjunct to the named series in that many of the soils mapped in the Study Area show development in the B horizon but often lack sufficient clay accumulation for an argillic horizon.

3 Taxadjunct refers to a soil map unit that is given the same name as a similar recognized existing soil series for expediency when defining a new soil series would be of limited use.

Source: AECOM 2012

Table 3.4-3 Limiting Values for Soil and Site Properties

Feature	Property	Property Values		
		Limiting	Somewhat Limiting	Not Limiting
Properties from Construction Materials: Reclamation (NRCS 2014b), modified for horizon use				
Too clayey	% Clay	≥ 40%	>30 to 40%	≤30%
Cobble content	Cobble by % weight	>50%	>25% to ≤50%	≤25%
	Cobble by % volume[1]	>35%	>16% to ≤35%	≤16%
Stone content	Stone by % weight	>15%	>5% to ≤15%	≤5%
	Stone by % volume[1]	>10%	>3% to ≤10%	≤3%
Carbonate content	Calcium Carbonate Equivalent	≥40%	>15% and <40%	≤15%
Sodium Content	Sodium Adsorption Ratio	>13	>4 and ≤13	≤4
Water Erosion	K factor	≥0.7	> 0.35 to <0.7	≤0.35
Low organic matter	% OM	0	>0 to <1%	≥1%
Too alkaline[2]	Soil pH (1:1 water)	>8.4	≥8.0 to ≤8.4	<8.0
Too acid[2]	Soil pH (1:1 water)	<5.5	≥5.5 to <6.0	≥6.0
Salinity	Electrical Conductivity	>16 mmhos/cm	≤8 to ≥16 mmhos/cm	<8 mmhos/cm
Too sandy	#4 sieve minus #200 sieve	≥85%	>70% and <85%	≤70%
Wind Erosion	Wind Erodibility Group	"1" and "2"	Not Applicable	All Other Groups
Droughty[3]	Available Water Capacity	≤0.05 cm/cm	>0.05 to <0.1 cm/cm	≥0.1 cm/cm
Depth to bedrock	Depth to bedrock	<50 cm	≥50 to ≤100 cm	>100 cm
Depth to cemented pan	Depth to cemented pan	<50 cm	≥50 to <100 cm	≥100 cm

Table 3.4-3 Limiting Values for Soil and Site Properties

Site Specific Property				
Too wet	Months saturated during growing season	Not Applicable	>3	≤3

Notes:

1 Cobble and stone content by volume are not NRCS (2014b) interpretation properties. Field observations of cobble and stone content by volume were converted to content by weight using NRCS 2014c

2 pH values modified per letter from Jack Isaacs (USFS) dated December 8, 2014

3 Horizon adjusted available water capacity limiting values from West National Technology Support Center (2014)

Abbreviations: mmhos = millimhos, cm = centimeter

Source: NRCS 2014b; USFS 2014b; Arcadis 2015d

Physical and chemical factors limiting soil quality and use as GM are present in the Study Area. The primary physical factor limiting suitability is excess rock fragment (cobble or stone) content. Acidity (low pH) and low organic material content are the primary chemical limitations. Less common limiting factors include excess clay content, droughtiness, carbonate content, excess sand content, and others. Depth to water saturated conditions, whether seasonal or perennial, are an issue limiting topsoil salvage for map units CFT and ENV and, to a lesser extent, the HPM and WSR units.

Major components of map units HAX, HBP, HPM, and RDX contain coarse rock fragments in amounts that limit the soil suitability of one or more horizons as GM. Soil horizons limited by excess rock fragment content are most commonly associated with soils that are shallow over bedrock, such as units HAX and RDX.

3.4.3.1 GM Availability

Soil suitability interpretations indicate that, for all soil components, suitability is best near the top of the profile and decreases with depth or is similar throughout the entire profile. **Table 3.4-4** presents the depth of soils classified as good, fair, and poor according to Soil Survey Staff (NRCS 2014b) criteria available within each map unit component as interpreted by Arcadis (2015d). The primary factors limiting quantity are depth to bedrock and depth to water saturated conditions. Shallow soils and rock outcrop that limit salvageable volume are interspersed throughout map units HAX and RDX. These map units represent 25 percent of the Study Area. Because the availability of soils for use as GM depends on the areas from which soils are salvaged, GM volumes available for reclamation are presented in **Chapter 4**.

Table 3.4-4 Distribution of Potential GM by Soil Map Unit

Map Unit	Component Name	% of unit	Limiting Criteria	Good Material (depth in inches)	Fair Material (depth in inches)	Poor Material (depth in inches)
CFT	Chubbflat	85	Too wet; too clayey; low OM; water erosion	0	24	34
	Turson	10	Low OM; too sandy; droughty	17	10	13
	Inclusion - Enochville	2	Too wet; too clayey; low OM, droughty	0	20	40
	Inclusion - Robana	2	Acidic; too clayey; low OM; water erosion	3	46	0
	Inclusion - Parkay	1	Acidic; too clayey; low OM; droughty; cobbles	3	30	7
DTL	--Not Rated--			0	0	0
ENV	Enochville	95	Too wet; too clayey; low OM; droughty	0	20	40
	Inclusion - Chubbflat	3	Too wet; too clayey; low OM; water erosion	0	24	34
	Inclusion - Robana	1	Acidic; too clayey; low OM; water erosion	3	46	0
	Inclusion - Turson	1	Low OM; too sandy; droughty	17	10	13

Table 3.4-4 Distribution of Potential GM by Soil Map Unit

Map Unit	Component Name	% of unit	Limiting Criteria	Good Material (depth in inches)	Fair Material (depth in inches)	Poor Material (depth in inches)
HAX	Hades	55	Stones; acidic; low OM; droughty	0	38	22
	Agassiz	25	Depth to bedrock; Acidic; too sandy; droughty	0	6	8
	Rock Outcrop	10	--Not Rated--	0	0	0
	Inclusion - Loamy-skeletal soils	5	Acidic; low OM; droughty; cobbles; stones; too clayey	2	28	6
	Inclusion - Moderately-deep soils	5	Acidic; low OM; droughty	0	38	0
HBP	Hagenbarth	60	Acidic; low OM; too clayey	17	43	0
	Parkay	30	Acidic; low OM; droughty; cobbles; stones; too clayey	2	28	6
	Inclusion - Robana	3	Acidic; too clayey; low OM; water erosion	3	46	0
	Inclusion - Woolsted	3	Acidic; low OM; water erosion	0	27	33
	Inclusion - clayey soils	3	Too clayey	6	24	0
	Rock Outcrop	10	--Not Rated--	0	0	0
HPM	Hagenbarth	50	Acidic; too clayey; low OM; cobbles	20	27	0
	Parkay	35	Acidic; low OM; droughty; cobbles; too clayey	3	30	7
	Ponds	7	--Not Rated--	0	0	0
	Inclusion - clayey soils	7	Too clayey	6	24	0
	Inclusion - Wet Soils	1	Too wet; too clayey; low OM; water erosion	0	24	34
PCM	Parkcity	70	Droughty; low OM	4	36	0
	Moonlight	15	Carbonate; low OM	21	17	26
	Inclusion - Fine-loamy soils	5	Carbonate; low OM	12	37	11
	Inclusion - Parkay	4	Acidic; low OM; droughty; cobbles; too clayey	3	30	7
	Inclusion - Hagenbarth	4	Acidic; low OM; too clayey	17	43	0
	Rock Outcrop	2	--Not Rated--	0	0	0
RDX	Ireland	45	Stones; cobbles; droughty; too sandy; depth to bedrock; carbonate	0	6	26
	Dipcreek	30	Carbonate; cobbles; droughty; depth to bedrock	0	10	6
	Rock Outcrop	15	--Not Rated--	0	0	0
	Inclusion - Xerorthents	5	Stones; cobbles; droughty; depth to bedrock	0	6	26
	Inclusion - Deep soils	3	Low OM; depth to bedrock	27	12	0
	Inclusion - Parkcity	2	Droughty; low OM	4	36	0
RXO	--Not Rated--			0	0	0
WSR	Woolsted	50	Acidic; low OM; water erosion	0	27	33
	Robana	40	Acidic; too clayey; low OM; Water erosion	3	46	0
	Inclusion - Hagenbarth	5	Acidic; low OM; too clayey	17	43	0
	Inclusion - Chubbflat	5	Too wet; too clayey; low OM; Water erosion	0	0	58

Notes:
1 Not all limiting factors apply to all horizons within a given component
2 OM = organic matter
Source: Arcadis 2015e

All soil map units (except DTL) contain soils rated as fair or good for use as GM; however, some map units have better combinations of suitability and volume. In general, within the Study Area, map unit PCM offers the best combination of volume and good quality soils for reclamation. Conversely, the Chubbflat and Enochville soils (primarily within units CFT and ENV) are limited by wetness and a relatively shallow water table. The drier narrow drainages, dominated by the Turson soil in units CFT and ENV, provide good soils that are not limited by wetness.

3.4.4 Erosion Potential

Soil erodibility characteristics determined by AECOM (2012) are presented in **Table 3.4-5**. In general, soils within the Study Area have moderate to low susceptibility to erosion by water, with the most susceptible soils being located in lower parts of the Study Area. Susceptibility to erosion by wind is generally low except in areas of soil unit HAX.

Soil erodibility factors (Kw) and (Kf) quantify soil detachment by runoff and raindrop impact. These erodibility factors are used to predict the long-term average soil loss from sheet and rill erosion under crop systems and conservation techniques. Factor Kw applies to the whole soil, and factor Kf applies only to the fine-earth (less than 2.0 mm) fraction. Kf was calculated using an empirical formula that incorporates several variables including the percentage of silt and sand, soil organic matter, soil structure, and permeability. This factor is modified according to the percentage (by volume) of rock fragments observed in the soil profile to produce the factor Kw. The higher the soil erodibility factors, the more susceptible the soil is to sheet and rill erosion by water. Soils within the Study Area are likely to be exposed at multiple depths during the life of proposed mining activities. Therefore, a general water erosion hazard, or susceptibility of a disturbed soil to water erosion, was determined for each component of soil map units based on a weighted average of Kw values presented in AECOM (2012). Soil horizons deemed unusable as GM (Arcadis 2015e) were included in erosion hazard calculations because these areas may be exposed during project activities.

For the purposes of this EIS, the soil EH rating was based on weighted average Kw as follows:

If $Kw < 0.25$, then erosion hazard = low (L)

If $0.25 \leq Kw \leq 0.40$, then erosion hazard = moderate (M)

If $Kw > 0.40$, then erosion hazard = high (H).

The weighted average EH soil map unit components where sufficient data are available are shown in **Table 3.4-5**. AECOM (2012) did not determine erodibility characteristics for the DTL or RKO map units. Data, including soil texture and coarse fragment percentages, used to determine the characteristics presented in **Table 3.4-5** are presented in AECOM (2012).

Table 3.4-5 Soil Erodibility Characteristics

Map Unit Symbol	Component Name	Kw Weighted Average	General Water Erosion Hazard	Wind Erodibility Group
CFT	Chubbflat	0.31	M	>2
	Turson	0.28	M	6
	Inclusion-Enochville	0.26	M	6
	Inclusion-Robana	0.42	H	6
	Inclusion-Parkay	0.24	L	7
DTL	Disturbed Land	NA		
ENV	Enochville	0.26	M	6
	Inclusion-Chubbflat	0.31	M	>2
	Inclusion-Robana	0.42	H	6
	Inclusion-Turson	0.28	M	6
HAX	Hades	0.11	L	3
	Agassiz	0.13	L	8
	Rock Outcrop	NA		
	Inclusion-loamy-skeletal soils	0.27	M	6
	Inclusion-moderately deep soils	0.13	L	3

Table 3.4-5 Soil Erodibility Characteristics

Map Unit Symbol	Component Name	Kw Weighted Average	General Water Erosion Hazard	Wind Erodibility Group
HBP	Hagenbarth	0.27	M	6
	Parkay	0.27	M	6
	Inclusion-Robana	0.42	H	6
	Inclusion-Woolsted	0.43	H	6
	Inclusion-clayey soils		NA	
	Inclusion-rock outcrop		NA	
HPM	Hagenbarth	0.28	M	6
	Parkay	0.24	L	7
	Inclusion-clayey soils		NA	
	Inclusion-wet soils	0.31	M	>2
	Inclusion-Ponds		NA	
PCM	Parkcity	0.09	L	7
	Moonlight	0.24	L	5
	Inclusion-fine-loamy soils	0.36	M	>2
	Inclusion-Parkay	0.24	L	7
	Inclusion-Hagenbarth	0.27	M	6
	Inclusion-rock outcrop		NA	
RDX	Ireland	0.04	L	7
	Dipcreek	0.23	L	7
	Rock Outcrop		NA	
	Inclusion-Xerorthents	0.04	L	7
	Inclusion-Deep soils	0.12	L	>2
	Inclusion-Parkcity	0.09	L	7
RKO	Rock Outcrop		NA	
WSR	Woolsted	0.43	H	6
	Robana	0.42	H	6
	Inclusion-Hagenbarth	0.27	M	6
	Inclusion-Chubbflat	0.31	M	>2

Notes:
NA Not assessed because of lack of data (e.g., clayey soil inclusions) or generally accepted low erosion hazards (e.g., rock outcrops, ponds)
Sources: AECOM 2012, 2015

A wind erodibility group (WEG) is a grouping of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to blowing. WEGs are not officially defined with respect to soil blowing susceptibility or potential. However, WEGs 1 and 2 are typically considered to have the highest susceptibility, WEGs 3 through 6 moderately high to moderately low susceptibility, and WEGs 7 and 8 have low susceptibility. WEG ratings presented in **Table 3.4-5** apply only to the surface layer of an undisturbed soil. Arcadis (2015d) evaluated WEG ratings for subsurface horizons for each soil component and determined that soils with the highest susceptibility to wind erosion (WEGs 1 and 2) are not present.

3.5 VEGETATION, RIPARIAN AREAS, AND WETLANDS

3.5.1 Vegetation Cover Types

Vegetation was characterized in the Study Area by identifying and mapping vegetation cover types, first by reviewing existing studies and then by completing field work. On-site vegetation baseline studies (BC 2012a,b,c) delineated types in the Study Area. Topography, microclimate, soils, and seed sources typically determine the locations of these five types (Steele et al. 1983). Two of these vegetation types (aspen [*Populus tremuloides*] and wetlands) were further divided into subtypes because the vegetation within exhibited wide differences in one of these characteristics (e.g., plant species and structure, soils, moisture). Aspen was divided into four separate strata and wetlands into two separate strata (BC 2012a,b,c). Vegetation cover types are shown on **Figure 3.5-1**, and include the following:

- Aspen forest (consists of four aspen forest strata defined by age, proportion conifer, and dryness)
- High-elevation rangeland
- Big sagebrush (*Artemisia tridentata*) shrubland
- Silver sagebrush (*Artemisia cana*) shrubland.

Wetland consists of two wetland strata:

- Emergent/ wetlands and adjacent drainages
- Shrub/scrub wetlands and adjacent drainages

As described in **Section 2.3.7.9**, quantitative richness-cover-wetness (RICHCOVWET) metric values were calculated for the vegetation cover types in the Study Area to evaluate the wildlife habitat quality of each in the Habitat Equivalency Analysis (HEA; Arcadis 2014a). **Table 3.5-1** summarizes the vegetation cover types that overlap the Study Area and their associated baseline RICHCOVWET values, and the locations of the cover types are shown on **Figure 3.5-1**. The cover types are further described below, largely summarizing BC's vegetation baseline technical report (BC 2012a).

Vegetation cover types and some associated plants in the Study Area can be important to pollinators. There is increasing evidence that many pollinators (such as honey bees [*Apis* sp.] and monarch butterflies [*Danaus plexippus*]) are in decline (USDA 2015, U.S. Fish and Wildlife Service [USFWS] 2015a). To address these population declines, the White House released a Presidential Memorandum – Creating a Federal Strategy to Promote the Healthy of Honey Bees and Other Pollinators on June 20, 2014. With this direction, the USDA and U.S. Department of the Interior (US DOI) issued the 2015 draft document: Pollinator-Friendly Best Management Practices for Federal Lands. This document guides federal land managers to effectively and efficiently use available resources and engage public and private partnerships in taking action for the conservation and management of pollinators and pollinator habitat. Currently, there are no federally listed threatened or endangered pollinator species or USFS sensitive pollinator species on the Caribou-Targhee National Forest (CTNF). Milkweed, which is an important plant to pollinators, and monarch butterfly habitat are not known to occur in the Study Area.

3.5.1.1 Aspen Strata

A broad band of aspen woodland is present on the upper slopes of Rasmussen Ridge. The aspen were divided into four stratum categories as follows:

- Aspen mature dry woodland - Stands in this stratum are those that appear to be dominated by mature aspen on drier sites and have little to no conifer presence.

- Aspen mature - Stands in this stratum are those that appear to be dominated by mature but not old aspen on mesic (wetter) sites and have little to no conifer presence.
- Aspen old growth - Stands in this stratum are those that appear to be dominated by mature to old aspen that are on mesic sites and have little to no conifer presence. These stands appear to meet the compositional, structural, and age definitions of USFS old-growth aspen cover type.
- Aspen/conifer mix - Stands in this stratum are those that appear to be dominated by a mix of mature aspen and conifer, but primarily conifer, or that are known to have substantial conifer in the understory. In addition to aspen, this stratum includes interior Douglas-fir (*Pseudotsuga menziesii var glauca*), lodgepole pine (*Pinus contorta*), and subalpine fir (*Abies lasiocarpa*). Certain areas within aspen/conifer mix stratum are dominated by conifers, particularly by Douglas-fir.

The Study Area also includes 0.9 acre of aspen woodland that were not included in the area surveyed during BC's baseline vegetation studies. This area of aspen woodland was mapped using aerial imagery and is depicted on **Figure 3.5-1** as "aspen stratum not classified."

Table 3.5-1 Vegetation Cover Types and Acreages as Depicted on Figure 3.5-1

Cover Type	Acres in Study Area	RICHCOVWET Value Calculated for HEA[1]
Aspen Mature Dry Woodland	310.0	0.76
Aspen Mature	76.7	0.78
Aspen Old Growth	5.8	0.64
Aspen/Conifer Mix	46.9	0.88
Aspen Stratum not Classified	0.9	N/A (not included in HEA)
Big Sagebrush Rangeland	735.7	0.46
Silver Sagebrush Rangeland	385.0	0.43
High-Elevation Rangeland	392.5	0.61
Shrub/Scrub Wetland	58.6	1.00
Emergent Wetland	261.1	0.89
Existing P4 South Rasmussen Mine Site	138.6	0.00
Reclaimed Areas	78.4	varies depending on age of reclaimed area
TOTAL	**2,490.2**	

Notes:
1 See **Section 2.3.7.9** for further information on how RICHCOVWET values were derived
Source: BC 2012a, 2012b, 2012c; Arcadis 2014a

The four aspen strata occur as a belt of aspen extending from northwest to southeast along the swale formed in Rasmussen Ridge at the outcrop of the Meade Peak Member of the Phosphoria Formation. Aspens favor upper-elevation drainages, which are the more protected portions of the southwest-facing ridge face. Topographic swales in the mountain slope are less exposed, and aspens benefit from increased moisture in these drainages. The Phosphoria Formation and protected drainages appear to provide favorable conditions for aspens.

In general, aspens are stressed and in decline throughout most of the western U.S. There is no single definitive cause for this decline, but it may be linked to climate change (Worrall et al. 2013). Changes in temperature and moisture regimes may be making aspens more susceptible to diseases and insect damage (Morelli and Carr 2011). In the Study Area, the aspens appear to be generally healthy, but there are some signs of stress, such as an occasional stand of dead trees.

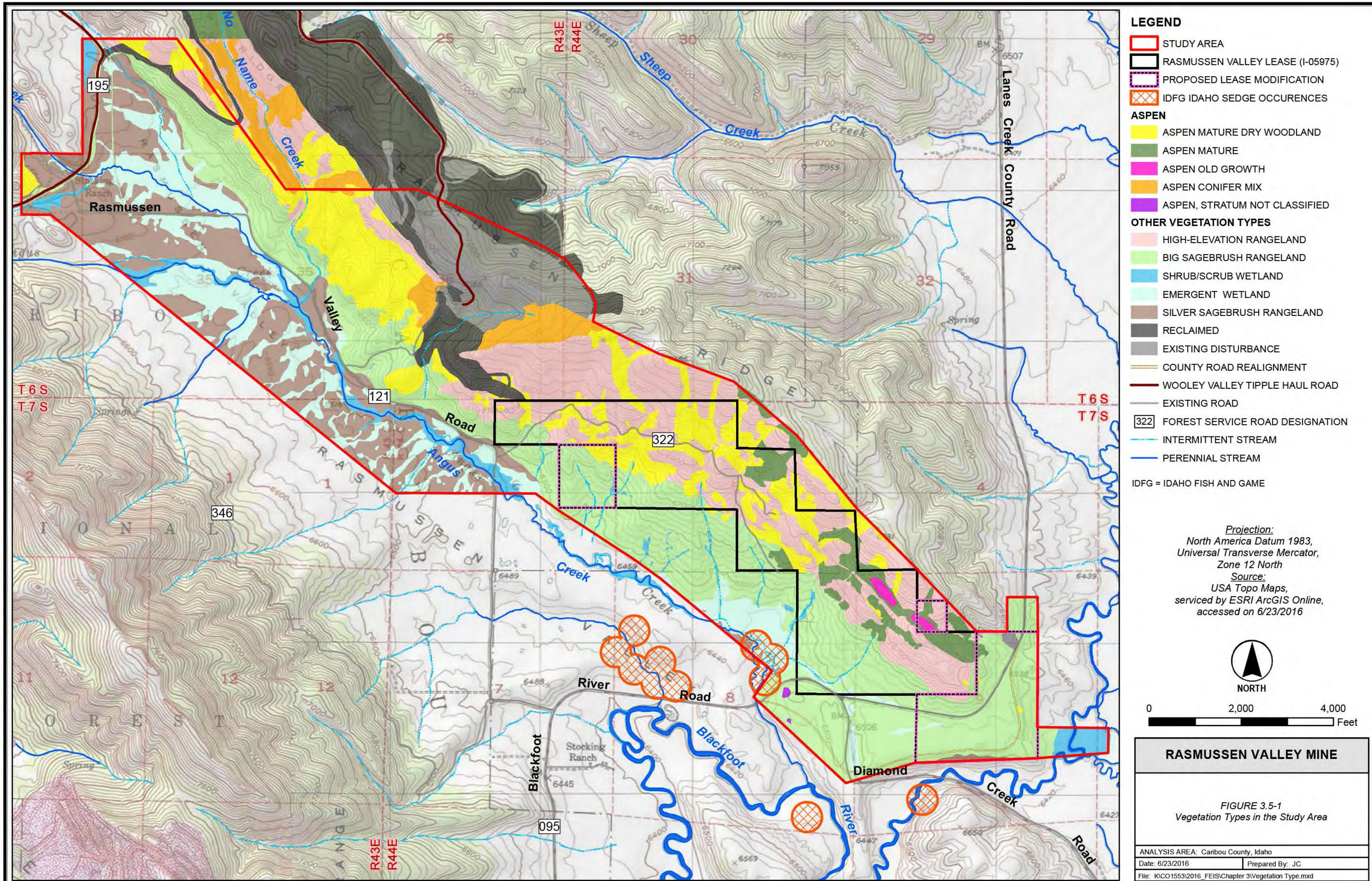


Figure 3.5-1 Vegetation Types in the Study Area

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Mountain pine beetle (*Dendroctonus ponderosae*) is affecting lodgepole pine in the mixed aspen/conifer areas, and this may reduce lodgepole pine numbers in this cover type significantly over the next several years (Krist et al. 2014). Aspens are the single dominant overstory tree within the four aspen strata, but a variety of woody species occupy the understory. These species include serviceberry (*Amelanchier alnifolia*), chokecherry (*Prunus virginiana*), bitterbrush (*Purshia tridentata*), mountain snowberry (*Symphoricarpos oreophilus*), Oregon grape (*Mahonia repens*), and wild rose (*Rosa woodsii*). Dominant grasses in the aspen strata include Timothy (*Phleum pratense*), Kentucky bluegrass (*Poa pratensis*), mountain brome (*Bromus marginatus*), and American needlegrass (*Achnatherum nelsonii*).

The aspen strata also provide optimum habitat for a variety of summer-flowering forbs. These include little sunflower (*Helianthella uniflora*), Indian paintbrush (*Castelleja miniata*), western blue flax (*Linum lewisii*), meadowrue (*Thalictrum occidentale*), wild geranium (*Geranium viscosissimum*), mariposa-lily (*Calachortus* spp.), beardtongue (*Penstemon cyaneus*), and tall mountain larkspur (*Delphinium occidentale*).

3.5.1.2 Big Sagebrush Rangeland

In the Study Area, big sagebrush rangeland occupies the high plains and the arid lower mountain slopes. Big sagebrush rangeland is an arid zone between lower-elevational cover-types (mesic emergent/ponded wetland and silver sagebrush [rangeland) and high-altitude plant communities that benefit from greater moisture found at higher elevations.

Big sagebrush rangeland is dominated by mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*), specifically with rabbitbrush (*Ericameria nauseosus*), bitterbrush, and mountain snowberry (present in lesser amounts). Mountain big sagebrush typically comprises 50 percent or more of plant cover in the shrub layer on big sagebrush rangeland.

Grasses and forbs grow in moderate to sparse quantities among the sagebrush. Both native and introduced grass species are widespread. Timothy is an introduced grass that is ubiquitous, and may be predominant among all grasses observed within both types of sagebrush rangeland. Mountain brome, a native grass, is common, and non-native grasses (such as Kentucky bluegrass, orchardgrass [*Dactylis glomerata*], and intermediate wheatgrass [*Thinopyrum intermedium*]) are widespread.

3.5.1.3 Silver Sagebrush Rangeland

In the Study Area, silver sagebrush rangeland occupies an elevational zone between mesic emergent/ponded wetland and big sagebrush rangeland. No precise line exists in nature between areas mapped as silver sagebrush rangeland and big sagebrush rangeland, as shown on **Figure 3.5-1**. Instead, a zone usually exists where the two dominant sagebrush species intermingle, but big sagebrush becomes increasingly dominant as elevation increases. In contrast, the line between silver sagebrush rangeland and mesic emergent/ponded wetland is more distinct because silver sagebrush, which requires more soil moisture than big sagebrush, cannot tolerate the prolonged saturation in the upper soil profile exhibited by emergent wetlands.

Although silver sagebrush is the dominant shrub identifying silver sagebrush rangeland, shrub cinquefoil (*Dasiphora fruticosa*) is also present. Common grasses and forbs include silvery lupine (*Lupinus argenteus*), yarrow (*Achillea millefolium*), and mountain brome. Other species, such as Timothy and Kentucky bluegrass, are also found within this cover type.

3.5.1.4 High-Elevation Rangeland

High-elevation rangeland occurs at higher elevations than big sagebrush rangeland, typically above 6,600 feet in elevation. Although many of the same plant species present in the high-elevation rangeland cover-type also occur in big sagebrush rangeland, the composition of the plant community changes. Big sagebrush is still found, but mountain snowberry in particular becomes more widespread. Increased moisture at higher elevations also favors a greater diversity of shrubs and some trees. Chokecherry, serviceberry, and snowbrush (*Ceanothus velutinus*) are common, and clusters of aspens occur.

Grass species in high-elevation rangeland are similar to those found on sagebrush rangeland. Timothy, Kentucky bluegrass, basin wildrye (*Elymus cinerus*), and mountain brome are widespread. Sandberg bluegrass (*Poa secunda*) is dominant on very exposed slopes, whereas cheatgrass (*Bromus tectorum*) has colonized rocky shale outcrops.

In addition to an increased diversity of shrubs, a greater variety of forbs is found at higher elevations. Species include Indian paintbrush, scarlet gilia (*Ipomopsis aggregata*), buckwheat (*Eriogonum* spp.), balsamroot (*Balsamorhiza sagittata*), and Canada goldenrod (*Solidago canadensis*).

3.5.1.5 Shrub/Scrub Wetland

In the Study Area, shrub/scrub wetlands are relatively narrow, disjointed willow corridors along Angus Creek and its headwater tributaries. Intensive cattle grazing has constricted the willow corridor along stretches of the creek, and in some areas, the cattle (with human assistance) have completely removed all woody vegetation.

The healthiest section of shrub/scrub wetlands is found at the western (upstream) corner of the area (NE¼ of S34, T6S, R43E) where Angus Creek turns west towards the Wooley Range. A healthy complex of willows, currants, and herbaceous riparian vegetation line the creek corridor in this zone, which is above the heavily grazed private ranch. Where cattle are not allowed to graze, the creek and a water table near the ground surface (seasonally saturated zone) support a broad wetland containing willows and currants of mixed ages.

The shrub/scrub wetland corridor along Angus Creek and its tributaries is composed of intermingled coyote willow (*Salix exigua*) and Geyer willow (*Salix geyeriana*) with some occasional golden currant (*Ribes aureum*). In many locations, only large old willows have survived being browsed by cattle. The herbaceous layer consists of wetland plants similar to those observed in the emergent wetlands (described below). Nebraska sedge (*Carex nebrascensis*), Baltic rush (*Juncus arcticus*), redtop bentgrass (*Agrostis stolonifera*), and graceful cinquefoil (*Potentilla gracilis*) dominate this herbaceous layer.

Although the shrub/scrub wetland community is identified as a vegetation type associated with Angus Creek and its tributaries, a small anomalous stand of willows is also located at the head of a spring on the lower slopes of Rasmussen Ridge (NE¼ NE¼ of T7S, R44E). This spring is sufficiently productive to sustain a mature cluster of willows underlain with sedges.

Several intermittent springs are found at the heads of narrow drainages on the relatively steep lower slopes of Rasmussen Ridge. These springs typically arise at 6,600 feet in elevation and flow during spring and early summer. Seasonal hydrology is adequate to support hydrophytic plant communities (adapted to grow in water) in segments of these narrow drainages, but flows are not sufficient to create defined channels. These seasonal mountain drainages support plant communities dominated by redtop bentgrass, Baltic rush, Nebraska sedge, and graceful cinquefoil, which distinguish the drainages from surrounding big sagebrush rangeland. These species also define wetlands on the valley floor, but largely because of steep topography, the mountainside wetland drainages have a vastly different character than wetlands on the Rasmussen Valley bottom.

3.5.1.6 Emergent Wetland

Emergent wetlands are areas dominated by forbs and grasses. This cover-type has largely been delineated as wetlands, but some areas of upland meadow may border the delineated wetlands. Sagebrush is generally absent in emergent wetlands as a result of the presence of soils saturated beyond the tolerance of common sagebrush species. The loss of saturation and the concurrent presence of scattered silver sagebrush typically indicate uplands in the Study Area. Areas mapped as emergent wetlands may also contain small or narrow areas of upland meadow.

The wettest portions of this vegetative community have dense stands of sedges and rushes. Beaked sedge (*Carex utricata [sun: C. rostrata*) and Nebraska sedge are dominant within ponded areas on the valley floor. Broad areas of Baltic rush also occupy highly saturated creek-side terraces. Bluejoint (*Calamagrostis canadensis*), redtop bentgrass, and meadow barley (*Hordeum brachyantherum*) are common wetland grasses. Timothy and Kentucky bluegrass become increasingly dominant at the drier outer portions of the wet bottomland and within upland meadow and range surrounding the delineated wetlands.

Graceful cinquefoil is also found within the emergent wetlands. The blooming period for graceful cinquefoil coincides with a period when seasonal wetlands bordering Angus Creek are drying up and some wetland species have died back. Graceful cinquefoil tolerates a wide range of moisture regimes, and this may account for its ubiquitous presence in emergent wetlands.

3.5.1.7 Existing Mine Site and Reclaimed Areas

The areas delineated as existing mine site on **Figure 3.5-1** are areas of active mining and unreclaimed mining areas and are generally devoid of vegetation. These areas are located at the P4 South Rasmussen Mine. Reclaimed areas are areas of previous mining activities that have been stabilized and seeded as part of approved reclamation plans. The reclaimed areas within the Study Area are newly reclaimed and have not established one or more dominant species. Bare ground dominates these areas with a mixture of grasses, mountain brome, intermediate wheatgrass, and various forb species.

3.5.2 Wetlands

Section 404 of the CWA (33 U.S.C §1344) prohibits discharges of dredge or fill material into waters of the U.S. (WOUS), including jurisdictional wetlands, without a Department of the Army Permit. Section 404 of the CWA is administered by the U.S. Army Corps of Engineers (USACE) with oversight by the USEPA.

Wetlands in the Study Area were delineated using the 1987 USACE Wetlands Delineation Manual (USACE 1987) and the Regional Supplement to the Corps of Engineers Wetlands Delineation Manual: Western Mountains, Valleys, and Coast Region (USACE 2008, 2010). Wetlands for most of the Study Area were delineated during investigations conducted in 2009, 2010, and 2011. The Study Area boundary was revised again after July 2011, and additional wetland delineation was conducted within the 22-acre spur area. **Figure 3.5-2** shows the locations of the wetland assessment areas in relation to the Study Area. Results of these delineations are described below.

Two wetland classifications were identified during the delineations: shrub/scrub wetlands and emergent wetlands. Shrub/scrub wetlands were dominated by Geyer’s willow with an understory similar to that of the wet meadow areas. Typical emergent wetland vegetation consisted of Kentucky bluegrass, Baltic rush, bentgrass (*Agrostis stolonifera*), creeping spikerush (*Eleocharis palustris*), Nebraska sedge, beaked sedge (*Carex utriculata*), water sedge (*Carex aquatilis*), and tall buttercup (*Ranunculus acris*). Altogether, the wetland delineations identified 438.2 acres of wetlands in the Study Area (64.6 acres of shrub/scrub wetland and 373.6 acres of emergent wetland).

3.5.2.1 Wetland Functions and Values

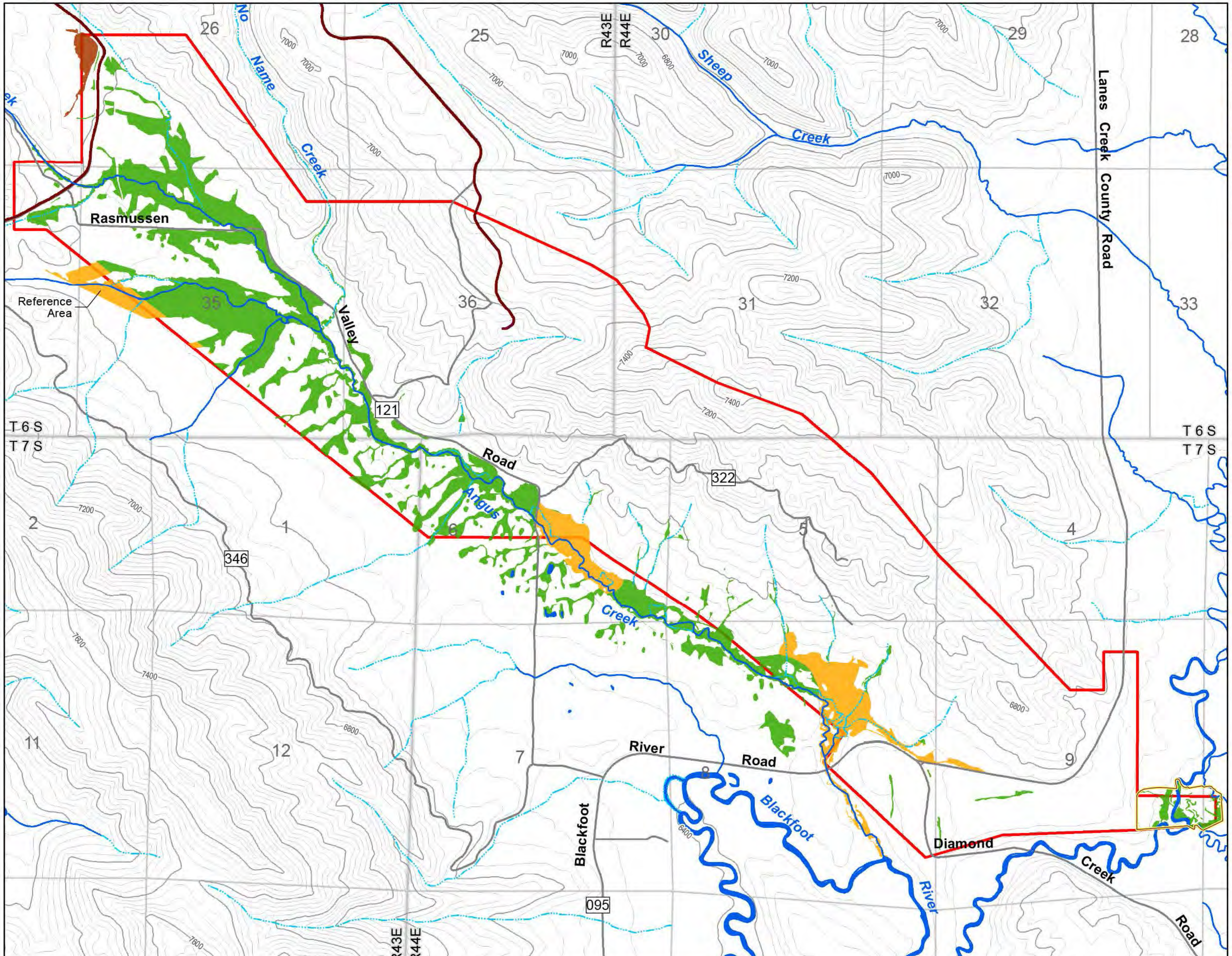
As recommended by the USACE Idaho Falls Regulatory Office, the 2008 Montana Department of Transportation Montana Wetland Assessment Method (MWAM), which is a variation of the Hydrogeomorphic Method (Berglund and McEldowney 2008), was used to assess wetlands in the Study Area. Though the MWAM was developed to evaluate wetlands impacted during linear transportation projects in Montana, it is applicable to Southeast Idaho.

The MWAM uses up to 12 functions or values to describe the condition and classification of a wetland. These include:

- Habitat for federally listed or proposed threatened or endangered plants or animals
- Habitat for plants or animals rated S1, S2, or S3 by the Montana Natural Heritage Program (modified for this project to use Idaho projects species listed in the State of Idaho as S1, S2, or S3)
- General wildlife habitat
- General fish habitat
- Flood attenuation
- Long- and short-term surface water storage
- Sediment/nutrient/toxicant retention and/or removal
- Sediment/shoreline stabilization
- Production export/terrestrial and aquatic food chain support
- Groundwater discharge/recharge
- Uniqueness
- Recreation/education potential

Each function and value is assessed; rated low, moderate, high, or exceptional; and assigned a number value ranging from 0.1 to 1.0 “functional points” according to the attributes of the wetland. These functional points are summed and then expressed as a percentage of possible total points. This percentage is then used with other criteria to provide an overall wetland ranking into one of four categories. Following are descriptions of each wetland category according to Berglund and McEldowney (2008).

- **Category I** - These wetlands are of exceptionally high quality and are generally rare to uncommon or are important from a regulatory standpoint. These wetlands can provide primary habitat for federally listed or proposed threatened or endangered species, represent a high quality example of a rare wetland type, provide irreplaceable ecological functions, exhibit exceptionally high flood attenuation capability, or are assigned high ratings for most of the assessed functions and values.



RASMUSSEN VALLEY MINE

FIGURE 3.5-2
Wetland Assessment Areas

ANALYSIS AREA: Caribou County, Idaho
Date: 6/23/2016 Prepared By: JC
File: K:\CO1553\2016_FEIS\Chapter3\Wetlands_11x17.mxd

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- **Category II** - These wetlands are more common than Category I wetlands and provide habitat for sensitive plants or animals, function at very high levels for wildlife and fish habitat, are unique in the region, or are assigned high ratings for many of the assessed functions and values.
- **Category III** - These wetlands are more common than Category II wetlands, generally less diverse, and often smaller and more isolated than Category I or Category II wetlands. They can provide many functions and values, although they may not be assigned high ratings for as many parameters as are Category I and II wetlands.
- **Category IV** - These wetlands are generally small, lack vegetative diversity, and have lower ratings for most functions.

Wetlands were delineated in discrete units called Assessment Areas (AAs) because of the Study Area's large size (**Figure 3.5-2**). AAs were assigned according to location within the Study Area, physical points of significant hydrologic change, or were contiguous up- and downstream from the Study Area to a maximum distance of 0.5 mile if no points of significant hydrologic change occurred within this distance. Within the AAs, wetlands were categorized individually according to MWAM. A reference area (AA 10) adjacent to the Study Area in a beaver pond complex was also included. The reference area was selected because it is outside the Study Area and is not subject to disturbance factors present in the Study Area. AA 10 can be used as a reference condition in comparing wetlands within the Study Area. Additional AAs were assigned to the pond complex to the southwest of the Study Area (AA 13) and the mountain streams flowing into Angus Creek in the center of the Study Area (AA 14). All AAs are summarized in **Table 3.5-2**. Wetland categories within and adjacent to the Study Area ranged from Category II wetlands (AA 1, 2, 5, and 10) to Category III wetlands (AA 3, 4, 6-9, 11-15).

Table 3.5-2 Summary of Functions and Values, by Assessment Area

Assessment Area (AA)	Wetland Acres	Actual Functional Points*	Possible Functional Points	Percent of Possible Score**	Wetland Category
1	4.6	7.9	11	71.8	**II**
2	43.8	8.0	11	72.7	**II**
3	10.0	5.7	11	51.8	**III**
4	27.2	5.4	11	49.1	**III**
5	25.3	7.4	11	66.4	**II**
6	21.7	6.55	11	59.5	**III**
7	21.7	5.2	11	47.3	**III**
8	17.0	6.0	11	54.5	**III**
9	49.1	6.65	11	60.5	**III**
10***	18.0	8.75	11	79.5	**II**
11	26.1	5.75	11	52.2	**III**
12	72.6	5.85	11	53.2	**III**
13	69.6	3.95	7	56.4	**III**
14	9.1	4.2	9	46.6	**III**
15	9.0	7.05	11	64.1	**III**
Total	**424.8**				

Notes:

* All wetlands had a low rating (0 functional points) for Listed/Proposed T&E Species Habitat because there was no suspected usable or incidental habitat for T&E species listed in the Pocatello Field Office Resource Area

** This percentage was used to help categorize the wetlands, where >80% = Category I; >65% = Category II; >35% = Category III; <35% = Category IV

*** Reference area outside Study Area

The following summarizes each AA and the wetland functions and values assessed. All wetlands had a low rating (0 functional points) for Listed/Proposed Threatened or Endangered Species Habitat because they contained no potentially usable or incidental habitats for threatened or endangered species listed in the PFO Resource Area.

Assessment Area 1

The wetlands in AA 1 are a mixture of emergent and shrub/scrub wetlands adjacent to Angus Creek south of Blackfoot River Road. The wetland is rated low for uniqueness in the area and moderate for Idaho Special Status Species (ISSS) Habitat, general wildlife habitat, and flood attenuation. Ratings for this wetland were restricted by size, disturbance ratings, and moderate structural diversity.

Assessment Area 2

The wetlands in AA 2 are a mixture of emergent and limited shrub/scrub wetlands adjacent to Angus Creek north of Blackfoot River Road. This wetland is hydrologically influenced by Angus Creek and three ephemeral mountain streams to the north and east of the wetland. The wetlands rated low for uniqueness in the area and moderate for ISSS Habitat, general wildlife habitat, and flood attenuation. Ratings for this wetland were restricted by size, disturbance ratings, and moderate structural diversity.

Assessment Area 3

The wetlands in AA 3 are a mixture of emergent and limited shrub/scrub wetlands adjacent to Angus Creek north of Blackfoot River Road. This wetland is hydrologically influenced by Angus Creek, two ephemeral mountain streams to the east, and surface drainage from the west. The wetlands rated low for uniqueness and flood attenuation and moderate for ISSS Habitat, general fish and wildlife habitat, short- and long-term surface water storage, sediment/nutrient/toxicant removal, and sediment/shoreline stabilization. Ratings for this wetland were restricted by size, disturbance ratings, channel structure, and structural diversity.

Assessment Area 4

The wetlands in AA 4 are a mixture of emergent and limited shrub/scrub wetlands adjacent to Angus Creek north of Blackfoot River Road. This wetland is hydrologically influenced by Angus Creek, four ephemeral mountain streams to the north and east, and surface drainage from the west. The wetlands rated low for uniqueness and moderate for ISSS Habitat, general fish and wildlife habitat, and sediment/nutrient/toxicant removal. Ratings for this wetland were restricted by disturbance ratings, channel structure, and structural diversity.

Assessment Area 5

The wetlands in AA 5 are a mixture of emergent and shrub/scrub wetlands adjacent to Angus Creek north of Blackfoot River Road. This wetland is hydrologically influenced by Angus Creek, an ephemeral mountain stream to the east, and surface drainage from the west. The wetlands rated low for uniqueness and moderate for ISSS Habitat, general fish and wildlife habitat, sediment/shoreline stabilization, and production export/food chain support. Ratings for this wetland were restricted primarily by disturbance factors.

Assessment Area 6

The wetland in AA 6 is dominated by emergent vegetation with a shrub/scrub component and is adjacent to Angus Creek north of Blackfoot River Road. This wetland is hydrologically influenced by Angus Creek and surface drainage from the west. The wetland rated low for uniqueness and flood attenuation and moderate for ISSS Habitat, general fish and wildlife habitat, short- and long-term surface water storage, sediment/nutrient/toxicant removal, and sediment/shoreline stabilization. Ratings for this wetland were restricted by disturbance ratings, channel structure, and structural diversity.

Assessment Area 7

The wetland in AA 7 is dominated by emergent vegetation with a shrub/scrub component and is adjacent to Angus Creek and Rasmussen Valley Road. This wetland is hydrologically influenced by Angus Creek, an ephemeral mountain stream to the east, and surface drainage from the west. The wetland rated low for uniqueness and flood attenuation and moderate for ISSS Habitat, general fish and wildlife habitat, short- and long-term surface water storage, sediment/nutrient/toxicant removal, and sediment/shoreline stabilization. Ratings for this wetland were restricted by size, heavy grazing, channel structure, and structural diversity.

Assessment Area 8

The wetland in AA 8 is mixture of emergent and shrub/scrub wetland vegetation and is adjacent to a western tributary to Angus Creek. This wetland is hydrologically influenced by surface drainage from the west. The wetland rated low for uniqueness and moderate for ISSS Habitat, general fish and wildlife habitat, flood attenuation, sediment/nutrient/toxicant removal, sediment/shoreline stabilization, production export/food chain support, and recreation/education potential. Ratings for this wetland were restricted mainly by grazing disturbances.

Assessment Area 9

The wetland in AA 9 is dominated by emergent vegetation with no shrub/scrub component and is adjacent to Angus Creek. This wetland is hydrologically influenced by Angus Creek and surface drainage. The wetland rated low for ISSS Habitat, uniqueness, and recreation/education potential, and moderate for general fish and wildlife habitat. Ratings for this wetland were restricted by disturbance and structural diversity.

Assessment Area 10 (Reference Site)

The wetland in AA 10 has an equal component of emergent and shrub/scrub wetland vegetation and is adjacent to Angus Creek in a beaver pond complex. This wetland is hydrologically influenced by Angus Creek and surface drainage. The wetland rated exceptional for general wildlife habitat and moderate for ISSS Habitat. Ratings for this wetland were only restricted by lack of a forested component.

Assessment Area 11

The wetland in AA 11 is dominated by emergent vegetation with no shrub/scrub component and is adjacent to a small tributary of Angus Creek. This wetland is hydrologically influenced by surface drainage. The wetland rated low for ISSS, general wildlife, and fish habitat; uniqueness; and recreation/education potential, and moderate for flood attenuation, sediment/nutrient/toxicant removal, sediment/shoreline stabilization, and groundwater discharge/recharge. Ratings for this wetland were restricted by seasonal flow, disturbance, and structural diversity.

Assessment Area 12

The wetland in AA 12 is dominated by emergent vegetation with no shrub/scrub component and is adjacent to a tributary of Angus Creek. This wetland is hydrologically influenced by the tributary and surface drainage. The wetland rated low for ISSS and general wildlife habitat, uniqueness, and recreation/education potential and moderate for general fish habitat, flood attenuation, sediment/nutrient/toxicant removal, and sediment/shoreline stabilization. Ratings for this wetland were restricted by disturbance and structural diversity.

Assessment Area 13

The wetlands in AA 13 are dominated by emergent vegetation with no shrub/scrub or forested component and are a part of a pond and channel complex that is mostly associated with small intermittent drainages west of Angus Creek. The wetlands are hydrologically influenced by tributary flow and surface drainage. The pond complex was analyzed as a complex because of the similar structure and functions of all the wetlands. The wetlands rated moderate for general wildlife habitat, sediment/nutrient/toxicant removal, production export/food chain support, and uniqueness. Ratings for this wetland were restricted by disturbance, seasonality, and structural diversity.

Assessment Area 14

AA 14 comprises seven non-contiguous polygons (named 14A through 14G), each of which includes separate seasonal mountain drainage along the western facing slope of Rasmussen Ridge. Because of the similar structures and sizes of the drainages, one was assessed (AA-14G) and represents the functional value for all the others, as allowed by the MWAM. During the assessment, each mountain drainage was examined to confirm that it corresponded with the individual drainage assessment and fell within the rating. The wetlands are dominated by emergent vegetation with a small percentage of shrub/scrub wetland vegetation. The wetlands are hydrologically influenced by surface drainage. The wetlands rated low for short- and long-term surface water storage and uniqueness, and moderate for ISSS and general wildlife habitat, sediment/nutrient/toxicant removal, sediment/shoreline stabilization, production export/food chain support, and groundwater discharge/recharge. Ratings for these wetlands were restricted by disturbance, seasonality, and structural diversity.

Assessment Area 15

AA 15 includes the wetlands associated with the Blackfoot River that were delineated in May of 2012 by BC as part of the expanded Study Area. The wetland is dominated by emergent vegetation with a shrub/scrub component adjacent to the Blackfoot River. This wetland is hydrologically influenced by the Blackfoot River and its tributaries. The wetlands rated low for uniqueness and recreation/education potential and moderate for ISSS and general wildlife habitat, general fish habitat, flood attenuation, and groundwater discharge/recharge. Ratings for this wetland were restricted by disturbance and stream entrenchment.

3.5.3 Old Growth Forest

The USFS document Characteristics of Old-Growth Forests in the Intermountain Region (USFS 1993) defines old-growth forests as:

> *"Old-growth forests are ecosystems distinguished by old trees and related structural attributes: old-growth encompasses the later stages of stand development that typically differ from earlier stages in a variety of characteristics which may include tree size, accumulations of large dead woody material, number of canopy layers, species composition and ecosystem function."*

Old-growth baseline studies were conducted in the Study Area to determine if forested areas met Region 4 old-growth definitions. BC developed study methods in conjunction with the USFS and BLM. Study methods are detailed in the Old Growth Forest Baseline Study Report (BC 2012c). The old growth baseline study found that one of the four aspen strata met old-growth definitions (the aspen old-growth stratum). Accordingly, 5.9 acres of forest stands within the Study Area were mapped as old growth (**Figure 3.5-1**). The 5.9 acres of old-growth forest are composed of two stands, each less than 4 acres in size, on BLM and private lands. These stands are dominated by mature to old aspen on mesic sites with little to no conifer presence and a prevalence of trees greater than 12 inches in diameter. The stands have abundant snags and down logs and contain trees that are more than 100 years old.

3.5.4 Noxious and Non-Native, Invasive Weeds

Executive Order (EO) 13112, Invasive Species, requires federal agencies to:

- Prevent the introduction of invasive species
- Detect and respond to and control populations of invasive species
- Monitor invasive species populations
- Provide restoration of native species and habitat conditions
- Conduct research and develop technologies to prevent the introduction of invasive species
- Promote public education on invasive species
- Not authorize, fund, or carry out actions that are likely to cause or promote the introduction or spread of invasive species

The State of Idaho has listed 64 species of noxious weeds (State of Idaho 2015). No extensive infestations of noxious weeds were observed during vegetation baseline studies (BC 2012a). However, Canada thistle and cheatgrass are present in scattered stands throughout the Study Area.

3.5.5 Fire Management

The CNF is managed in accordance with the National Fire Plan, Ten-Year Comprehensive Strategy and Implementation Plan, and Cohesive Strategy to improve fire prevention and suppression, to assist rural communities, to reduce hazardous fuels, and to restore fire-adapted ecosystems (USFS 2003). The BLM also manages public land in accordance with the National Fire Plan as well as local fire plans (BLM 2012a).

No documented complete fire history is readily available for the Study Area; however, general fire behavior and frequency can be summarized by characteristics of the vegetation communities in the Study Area. The following fire ecology descriptions discuss general fire ecology and occurrence in the Study Area.

3.5.5.1 Aspen

Aspen is classified as Fire Regime III (Hardy et al. 2001). Fire frequencies in aspen range between 25 and 100 years (63 years mid-range) with mixed severity (Loope and Gruell 1973). Fuel loads range from more than 6 tons per acre. Pure stands of aspen are particularly susceptible to mortality of aboveground stems from fire, but aspen is well adapted to regeneration by sprouting following fire (Jones and DeByle 1985; Mutch 1970). Specific site and climatic conditions are necessary before fires can ignite and spread, as aspen stands do not easily burn and often act as natural fuel breaks during wildland fires. Fires generally do not occur in young aspen stands. In older stands, during the warmest/driest months of the year, abundant fuel can lead to higher severity fires.

3.5.5.2 Sagebrush Shrubland

Historically, natural fires of stand replacement helped to maintain a mosaic of shrublands and perennial grasslands throughout the sagebrush steppe ecosystem. Pre-settlement fire return intervals in mountain big sagebrush communities ranged from 15 to 25 years. Alterations of historical fire regimes have resulted in major successional changes in regions dominated by mountain big sagebrush and other sagebrush species, and the introduction of exotic annual grasses has modified the role of fire across the landscape. In general, fire is less common in mountain big sagebrush shrubland than in pre-settlement times. Mountain big sagebrush is readily killed by fire, and post-fire recovery takes at least 15 years, with more severe fires resulting in slower recovery. Plants that are top-killed by fire do not re-sprout; instead, post-fire re-establishment is from seed. Mountain big sagebrush communities often have low fuel loads; consequently, after fire, the community may become a patchy mosaic of burned and unburned areas (Johnson 2000).

3.5.5.3 Wetland and Riparian

Natural fire is generally infrequent in this vegetation type, though the dominant cover type adjacent to the riparian plant community usually dictates its natural/historical fire rotation. For those larger riparian areas, the natural/historical fire rotation is estimated to range from 200 to 300 years or more; these are thought to be stand-replacing when they occur.

3.6 TERRESTRIAL WILDLIFE

The Idaho Department of Fish and Game (IDFG) manages wildlife in the State of Idaho, including on federal lands. Idaho Code Section 36-103 states that:

> *"All wildlife, including all wild animals, wild birds, and fish, within the State of Idaho, is the property of the State of Idaho. It shall be preserved, protected, perpetuated, and managed. It shall only be captured or taken at such times or places, under such conditions, or by such means, or in such manner, as will preserve, protect, and perpetuate such wildlife, and provide for the citizens of this state and, as by law permitted to others, continued supplies of such wildlife for hunting, fishing and trapping."*

As discussed in the previous section (**Section 3.5**), prevalent vegetation types in the Study Area are big sagebrush, silver sagebrush, and high-elevation rangelands; aspen woodland (consisting of four aspen strata); and wetlands. Stands of aspen with old-growth characteristics occur in small areas. These vegetation types and the variations within the communities provide habitats for terrestrial wildlife species.

In general, the aspen woodlands are the most productive woodland community type in the CNF in terms of wildlife diversity and herbaceous cover (USFS 2003). These woodlands provide areas for big game calving, browse and forage for a variety of wildlife, nesting areas for birds, and security areas. The aspen strata in the analysis area had relatively high baseline RICHCOVWET metric values, reflecting their relatively high wildlife habitat value (Arcadis 2014a).

Wetland and riparian habitats occur primarily along Angus Creek. Many of the species known or suspected to occur in the Study Area depend directly on riparian areas or use these habitats at some time during their lives (USFS 2003). The high value of wetlands as wildlife habitat is reflected in the relatively high RICHCOVWET values for these habitats (Arcadis 2014a).

Rangeland communities, including sagebrush, also provide a variety of habitats for wildlife species. These areas, however, had relatively lower RICHCOVWET values compared to aspen woodlands and wetlands (Arcadis 2014a).

TRC Environmental Corporation conducted several wildlife surveys to determine wildlife use of the Study Area (TRC 2012a,b,c). The TRC survey areas included the Study Area and an additional 0.5-mile buffer area for great gray, boreal, and flammulated owls and a 3-mile buffer for greater sage-grouse and sharp-tailed grouse winter use. The survey years and types of survey are summarized in **Table 3.6-1**.

Table 3.6-1 Wildlife Surveys Completed in the Study Area

Survey Year	Wildlife Survey
2010	• Great Gray, Boreal, and Flammulated Owl Nocturnal Calling Surveys • Winter Track Surveys • Northern Goshawk and Three-toed Woodpecker Diurnal Calling Surveys
2011	• Big Game Winter Survey • Greater Sage-Grouse and Sharp-tailed Grouse Lek Surveys • Aerial Raptor Nest Survey • Northern Goshawk and Three-toed Woodpecker Diurnal Calling Surveys • Passerine/Small Bird Surveys • Raptor/Large Bird Surveys • Waterfowl/Shorebird Surveys • Pygmy Rabbit Surveys • Acoustic Bat Surveys
2012	• Greater Sage-Grouse and Sharp-tailed Grouse Winter Survey • Big Game Winter Survey • Great Gray, Boreal, and Flammulated Owl Nocturnal Calling Surveys • Winter Track Surveys

Source: TRC 2012a,b,c

The sections below discuss mammals, including big game, predators, and bats; and birds, including upland game birds, migratory birds, raptors, passerines/small birds, and waterfowl/water birds. Threatened, Endangered, Proposed, and Candidate Species; Sensitive Species; and Management Indicator Species of wildlife are discussed in **Section 3.8**.

3.6.1 Mammals

Many mammalian species occur or potentially occur within the Study Area. Mammal species that have been directly observed or detected within the Study Area include the big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans*), hoary bat (*Lasiurus cinereus*), western small-footed myotis (*Myotis ciliolabrum*), long-eared myotis (*Myotis evotis*), little brown myotis (*Myotis lucifugus*), long-legged myotis (*Myotis volans*), Yuma myotis (*Myotis yumanensis*), longtail weasel (*Mustela frenata*), striped skunk (*Mephitis mephitis*), coyote (*Canis latrans*), red fox (*Vulpes vulpes*), yellow-bellied marmot (*Marmota flaviventris*), deer mouse (*Peromyscus maniculatus*), sagebrush vole (*Lagurus curtatus*), snowshoe hare (*Lepus americanus*), mountain cottontail (*Sylvilagus nuttalli*), elk (*Cervus canadensis*), mule deer (*Odocoileus hemionus*), and moose (*Alces alces*) (TRC 2012c).

3.6.1.1 Big Game

The Study Area supports three species of big game: elk, moose, and mule deer. The IDFG considers the Study Area summer range for mule deer, and there is parturition and rearing habitat for both mule deer and elk in the Study Area. This includes moist areas with dense understory for cover and forage, such as willows, aspen stands, and chokecherry/serviceberry thickets. Elk also forage in highly productive wet meadows, such as those found in Rasmussen Valley, when calves become more mobile. Both elk and moose winter in the Study Area, mostly on high ridges that are blown relatively snow-free (Wackenhut 2014).

Winter is the most difficult season for these species because food is limited and energy expenditures are higher than during other seasons. Winter range refers to the habitats on which big game species depend to minimize their energy expenditures and increase their chances of surviving severe winter weather. Winter range is crucial for long-term maintenance of big game populations (USFS 2003). Because of the high variability of winter severity, fall body condition, forage condition, and disturbance factors, the IDFG believes that all existing winter range and potential winter range should be recognized and protected to the extent possible (Wackenhut 2014).

TRC conducted aerial surveys for big game in the Study Area and a 3-mile buffer on April 10 and 11, 2011. TRC also noted observations of big game during the aerial grouse lek survey conducted on April 22, 2011 (TRC 2012b). In addition, TRC conducted an aerial survey for wintering grouse on February 7, 2012, during which observations of big game were noted (TRC 2012c). Eleven elk (10 adults and one dead yearling) and 15 moose (13 adults and two yearlings) were observed during the 2011 big game aerial survey. Additionally, 12 adult elk and 12 moose were recorded incidentally during the 2011 aerial grouse lek survey (TRC 2012b). Twelve adult elk and 12 adult moose were also observed during the 2012 wintering grouse survey (TRC 2012c).

Elk occurred in groups of one to four individuals during the 2011 big game survey, and 12 individuals were recorded as a group during the 2011 grouse lek aerial survey. This group of elk was observed on the southwest-facing slope just below the top of a steep unnamed ridge 1 mile southwest of the Rasmussen Valley Mine area. Nine of the 11 individuals observed during the big game survey occurred in the bottoms adjacent to Sheep Creek (TRC 2012b). During the 2012 wintering grouse survey, biologists recorded elk in groups of one to six individuals (TRC 2012c).

Moose were observed predominantly as individuals or pairs, but two groups of three individuals were recorded during the 2011 big game aerial survey. Moose observations were distributed across the survey area in Rasmussen and Upper Valleys, in the lower reaches of small creek tributaries, and on west-facing slopes (TRC 2012b). During the 2012 wintering grouse survey, moose were generally observed at higher elevations along ridges compared to the more dispersed locations observed in April 2011 (TRC 2012c).

3.6.1.2 Predators

Carnivore species identified by their tracks during 2010 and 2012 winter track surveys in the Study Area included coyote, weasel (*Mustela* sp.), and red fox (TRC 2012a, 2012c). Special Status carnivore species that may occur in or pass through the Study Area are discussed in more detail in **Section 3.8**.

3.6.1.3 Bats

Habitats in the Study Area are likely to support several bat species. Roosting habitats for bats (trees and rock outcrops) may be present in the Study Area, and bats may use all of the Study Area's habitats for foraging. Wooded openings, road cuts, and riparian areas often concentrate commuting and foraging bats. Wetlands provide water sources where bats drink and are important foraging locations because of high concentrations of insects (Taylor 2006).

From June 15 to October 31, 2011, fixed-point and mobile acoustic bat monitoring studies recorded 17,512 call files containing 17,987 bat passes. In general, bat activity was greatest between 9:00 p.m. and 11:00 p.m., and overall seasonal activity peaked between late June and mid-July. The mobile survey recorded most bat activity along a road that cut through mature coniferous forest to the south of the Study Area (Rodriguez 2012; TRC 2012b).

Myotis species (with a characteristic frequency of 40 kilohertz [kHz]), comprised 55.6 percent of the combined fixed-point and mobile bat sequences, and long-legged myotis appeared to be the most commonly recorded species in that acoustic group. Other species that likely were detected (acoustic characteristics overlap, so some sequences cannot be identified to species with certainty) include pallid bat (*Antrozous pallidus*), big brown bat, silver-haired bat, hoary bat, western small-footed myotis, long-eared myotis, little brown myotis, and Yuma myotis. The occurrence of the pallid bat may be questionable because of a lack of records for the area and call characteristics that overlap those of other species (Rodriguez 2012; TRC 2012b). Special Status species of bats are discussed further in **Section 3.8**.

3.6.2 Birds

More than 220 species of birds occur or potentially occur in the Study Area and vicinity (TRC 2012c). Major groups of birds present in the Study Area include upland game birds; migratory birds; raptors, passerines, and small birds; and water birds.

3.6.2.1 Upland Game Birds

Species of upland game birds known to occur in the Study Area include the ruffed grouse (*Bonasa umbellus*), greater sage-grouse (*Centrocercus urophasianus*), dusky grouse (*Dendragapus obscrurus*), and Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus*) (TRC 2012c). Although grouse tracks were noted during the 2010 and 2012 winter track surveys, they could not be identified to species (TRC 2012a, 2012c). Aerial surveys specifically targeting greater sage-grouse and Columbian sharp-tailed grouse (Special Status species discussed in **Section 3.8**) were conducted in spring 2011 (April 10 to 11 and April 21 to 22) and winter 2012 (February 7). Fifteen ruffed grouse were observed during the April 10 to 11, 2011 survey. The ruffed grouse were roosting on the ground at the margins of aspen groves (TRC 2012b). Ruffed grouse likely breed within the Study Area, as evidenced by observations of drumming in the area during the 2010 late winter/early spring owl surveys. Other grouse observed incidentally in the Study Area and vicinity during 2011 wildlife surveys included three dusky grouse, 19 greater sage-grouse, and one Columbian sharp-tailed grouse (TRC 2012b). The latter two species are discussed in **Section 3.8**. Eighteen Columbian sharp-tailed grouse and one dusky grouse were observed within 3 miles of the Study Area during the February 7, 2012 winter grouse survey (TRC 2012c).

3.6.2.2 Migratory Birds

Migratory birds include species that spend the winter in the southern latitudes, fly north to nest, and fledge their young in the summer. Although some migrate from the Arctic Circle to the southern tip of South America, others only move from Idaho to Arizona (Groves et al. 1997). The Migratory Bird Treaty Act (MBTA [16 U.S.C. 703-712]) is a federal statute that makes it unlawful to take any migratory bird, part, nest, egg, or product thereof, with “take” defined as to pursue, hunt, shoot, wound, kill, trap, capture, or collect; or to attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect. Most species of birds in the U.S. are legally protected under the MBTA. Exceptions to this statute include game and non-native species. An executive order was issued in 2001 (EO 13186, 66 Fed. Reg. 3853 [2001]) outlining the responsibilities of federal agencies with respect to migratory birds. In 2010, pursuant to this Order, the BLM signed a Memorandum of Understanding (MOU), with the USFWS (the agency responsible for enforcing the MBTA) to promote the conservation of migratory birds (BLM and USFWS 2010). In the MOU, the BLM, and USFWS agree to work collaboratively to identify and address issues that affect species of concern, such as migratory bird species listed in the Birds of Conservation Concern (BCCs) (USFWS 2008) and the USFWS Focal Species initiative. The USFWS signed a similar MOU with the USFS in 2008 (USFS and USFWS 2008).

BCCs are species (beyond those already designated as federally threatened or endangered) that represent the highest conservation priorities of the USFWS. In USFWS (2008), BCCs are listed by Bird Conservation Regions (BCRs), which are broad, ecologically distinct geographic regions in North America that have similar bird communities, habitats, and resource management issues. The Study Area is located within BCR 9 (Great Basin; USFWS 2008). BCCs for this BCR that have the potential to occur in the Study Area are listed in **Table 3.6-2**.

Table 3.6-2 Birds of Conservation Concern with the Potential to Occur in the Study Area

Common Name	Scientific Name
Bald eagle*	*Haliaeetus leucocephalus*
Brewer's sparrow*	*Spizella breweri*
Golden eagle*	*Aquila chrysaetos*
Greater sage-grouse*	*Centrocercus urophasianus*
Green-tailed towhee*	*Pipilo chlorurus*
Lewis's woodpecker	*Melanerpes lewis*
Loggerhead shrike	*Lanius ludovicianus*
Long-billed curlew*	*Numenius americanus*
Marbled godwit	*Limosa fedoa*
Peregrine falcon	*Falco peregrinus anatum*
Sage sparrow*	*Amphispiza belli*
Sage thrasher*	*Oreoscoptes montanus*
Virginia's warbler	*Oreothlypis virginiae*
Williamson's sapsucker	*Sphyrapicus thyroideus*
Willow flycatcher*	*Empidonax extimus*

Notes:
* Observed during baseline biological surveys
Source: TRC 2012a, 2012b, 2012c

Raptors that are known to occur in the Study Area and vicinity include five species of owls; one species of vulture; and nine species of hawk-like birds that include falcons, eagles, buteos, accipiters, and harriers (TRC 2012c). Many raptors nest in trees with large, sturdy branches or on cliff walls. Forested habitat in the Study Area suitable for nesting raptors is composed of mature aspen woodland and mixed aspen/conifer forests. Raptors may also use all of the habitats in the Study Area to hunt for prey.

An aerial survey of the Study Area and 1-mile buffer conducted on May 7, 2011 located 21 raptor and corvid (e.g., crow, raven) nests that were primarily located in aspen trees (TRC 2012b). Five nests (three of which were active) were identified as red-tailed hawk (*Buteo jamaicensis*) nests. Two of these active nests were within the Study Area. One American kestrel (*Falco sparverius*) nest was identified to the northeast of the Study Area, but activity status for this nest was undetermined. The other 15 nests did not have birds associated with them; three were recorded with undetermined activity, and 12 were recorded as inactive. An additional 104 nests of undetermined raptor/corvid species and undetermined activity were recorded incidentally during the aerial big game and grouse lek survey of the Study Area and 3-mile buffer in April 2011 (TRC 2012b).

Raptor/large bird (RLB) use surveys were conducted to evaluate use of the Study Area by raptors and other large birds from June to September 2011. At least 1,427 individuals representing 22 species were recorded. Red-tailed hawks and American kestrels were the most common species observed. Other species included the turkey vulture (*Cathartes aura*), bald eagle, northern harrier (*Circus cyaneus*), sharp-shinned hawk (*Accipter striatus*), Cooper's hawk (*Accipiter cooperii*), northern goshawk (*Accipter gentilis*), Swainson's hawk (*Buteo swainsoni*), and golden eagle. RLB use of the Study Area was almost four times higher during the spring/summer than during the fall (TRC 2012b).

In addition to the general raptor surveys described above, TRC also conducted targeted surveys for Special Status raptor species, including the great gray owl (*Strix nebulosa*), boreal owl (*Aegolius funereus*), flammulated owl (*Psiloscops flammeolus*), and northern goshawk (TRC 2012a,b,c). Use of the Study Area by Special Status species of raptors is discussed in **Section 3.8**.

3.6.2.3 Passerines and Small Birds

A variety of passerine/small bird (PSB) species use the habitats in the Study Area. The shrubland habitats provide nesting and foraging habitats for small birds that use open landscapes, whereas the aspen and aspen/mixed conifer forests provide forage and shelter for other species, including cavity-nesting birds like chickadees and woodpeckers. Riparian and wetland areas are extremely important habitats for small migratory birds. More bird species rely on riparian habitats than all other western rangeland vegetation types combined (Nicholoff 2003). Riparian areas provide crucial habitat for nesting, wintering, and migrating birds, and riparian bird diversity can be an indicator of ecosystem health. The diversity of structure and cover provides nesting habitats, hiding and thermal cover, and food (insects, seeds, and vegetation) for a variety of bird species. The water bodies provide a source of water and food for aerial insectivores. Riparian vegetation along the streams and drainages in the Study Area supports a variety of small migratory bird species, such as warblers, flycatchers, and sparrows.

PSB use surveys were conducted to evaluate use of the Study Area by passerines and other small birds from June to September 2011. At least 3,346 individuals representing 60 species were recorded, with an additional four species recorded as incidental observations. Sparrows (including chipping sparrows [*Spizella passerina*], green-tailed towhees, vesper sparrows [*Pooecetes gramineus*], white-crowned sparrows [*Zonotrichia leucophrys*], and Brewer's sparrows) were the dominant PSB group, followed by thrushes (including American robins [*Turdus migratorius*] and mountain bluebirds [*Sialia currucoides*]), blackbirds (including Brewer's blackbirds [*Euphagus cyanocephalus*] and western meadowlarks [*Sturnella neglecta*]), warblers (primarily yellow-rumped warblers [*Dendroica coronata*]), waxwings (cedar waxwings [*Bombycilla cedrorum*]), and finches (primarily American goldfinches [*Spinus tristis*]). Wet meadows supported the highest PSB use and species richness in the Study Area, whereas big sagebrush rangeland exhibited the lowest PSB use and species richness. PSB abundance was higher in the fall than during the spring/summer surveys (TRC 2012b).

3.6.2.4 Water Birds

Water birds, including gulls, herons, rails, cranes, shorebirds, and waterfowl, are unique in that they are highly adapted to surface waters and associated habitats. Water birds typically nest near and forage in open water habitats, such as lakes, ponds, rivers, streams, and wetlands. TRC recorded water birds during the 2011 RLB and PSB point-count surveys. In addition, TRC conducted three road-based waterfowl and shorebird surveys in the Study Area between early June and late July of 2011. To conduct these surveys, TRC biologists slowly drove accessible public roads within and directly adjacent to the Study Area near aquatic habitats and recorded all water bird observations (TRC 2012b).

Gulls, primarily Franklin's gulls (*Leucophaeus pipixcan*), California gulls (*Larus californicus*), and ring-billed gulls (*Larus delawarensis*), were the most numerous of all birds recorded during the combined wildlife surveys in 2011, with a total of 5,387 individuals observed (2,686 during waterfowl/shorebird surveys, 948 during RLB surveys, 691 during PSB surveys, and 880 during incidental observations). Observations of gulls during all wildlife surveys combined revealed several patterns. Gulls were recorded from June 4 through August 5, 2011, and 98 percent (5,295 individuals) of the observations were recorded in June, with 85 observations in July and 7 in August. Seventy-seven percent (4,123 individuals) were observed between 5:00 a.m. and 9:00 a.m., and those individuals were most often seen flying southeast through Rasmussen Valley or along the northeast-facing slopes of the ridge just south of the Study Area. Based on observations on several early mornings, the gulls typically came in from north and west of the Study Area and moved into the Upper Valley, probably to forage. The remaining 24 percent were observed between 10:00 a.m. and 4:00 p.m. Many of those individuals were Franklin's gulls, which tended to be seen along the south-central portion of the Study Area in Rasmussen Valley foraging in mid- to late afternoon (TRC 2012b).

Other less numerous water bird species observed in the Study Area and/or immediate vicinity during baseline surveys included the Canada goose (*Branta canadensis*), canvasback (*Aythya valisineria*), gadwall (*Anas strepera*), green-winged teal (*Anas crecca*), mallard (*Anas platyrhynchos*), common merganser (*Mergus merganser*), pied-billed grebe (*Podilymbus podiceps*), American white pelican (*Pelecanus erythrorhynchos*), great blue heron (*Ardea herodias*), snowy egret (*Egretta thula*), white-faced ibis (*Plegadis chihi*), killdeer (*Charadrius vociferous*), sandhill crane (*Grus canadensis*), spotted sandpiper (*Actitus macularia*), willet (*Tringa semipalmata*), long-billed curlew (*Numenius americana*), Wilson's phalarope (*Phalaropus tricolor*), and Wilson's snipe (*Gallinago gallinago*) (TRC 2012b). Canada goose, mallard, sandhill crane, great blue heron, killdeer, spotted sandpiper, and Wilson's snipe all showed evidence of breeding in the Study Area and immediate vicinity (e.g., paired courtship behavior, active nests, defense of nesting territories, and/or young observed). Common mergansers, which only were observed incidentally in the Narrows south of the Study Area, also were recorded breeding, with six young fledged (TRC 2012b). Special Status water bird species are discussed in **Section 3.8**.

3.7 FISHERIES AND AQUATIC RESOURCES

Surface water resources within and near the Study Area, which may provide habitat for fish and other aquatic organisms, are described in detail in **Section 3.3**, and wetlands and riparian areas are discussed in **Section 3.5.2**. These streams, wetlands, and riparian habitats provide habitats for a variety of fish, amphibians, reptiles, and benthic organisms such as macroinvertebrates. The Rasmussen Valley baseline aquatic resources study report (GEI 2012), Aquatic Biological Monitoring of No Name Creek and South Rasmussen Drainage, 2013 (GEI 2014), and the Aquatic Biological Sampling Data Report for South and Central Rasmussen Ridge Area Streams, 2014 (GEI 2015) include an assessment of the aquatic habitat, fish populations, fish tissue analysis, macroinvertebrate populations, macroinvertebrate tissue analysis, amphibian populations, and reptile populations conducted during 2009 through 2014. This section summarizes the findings of these studies for locations in and near the Study Area. The sampling area surveyed for fisheries and aquatic resources for the Rasmussen Valley baseline aquatic resources study included stream segments that are all within the Blackfoot River drainage, as well as the headwaters of the Blackfoot River, Lanes Creek, Angus Creek, and an unnamed tributary of Lanes Creek south of Sheep Creek

(GEI 2012). This baseline study sampled seven sites along these streams: AC-1, AC-2, BFR-1, BFR-2, LC-1, LC-2, and UT-1 in a sampling area that extended outside the Study Area (**Figure 3.7-1**). The South and Central Rasmussen Ridge Area Streams study included stream segments within Angus Creek, No Name Creek, Sheep Creek, South Fork Sheep Creek, Bear Canyon, Coyote Creek, South Fork Timber Creek, and Slug Creek. This study sampled 20 sites along these drainages: BAC-1, BAC-2, BAC-3, BAC-4, BNNC-1, BNNC-2, BNNC-3, BNNC-4, BSC-1, BSC-2, BSC-3, BSC-4, BSRD-1, BSRD-2, BSRD-3, BSRD-4, BBC-1, BCC-1, BSFTC-1, and BSLUG-1. Based on proximity to the Study Area, the following drainages were considered: Angus Creek, No Name Creek, Sheep Creek, and South Fork Sheep Creek. The remaining drainages are well outside the Study Area and were considered reference locations in the GEI (2015) report; therefore, they are not evaluated in this section. **Table 3.7-1** summarizes the locations and survey activities for fisheries and aquatic resources conducted within or downgradient of the Study Area.

3.7.1 Aquatic Habitat

GEI surveyed the habitat using a modified method based on the R1/R4 procedures for inventorying fish habitat developed by the USFS (Overton et al. 1997). This method includes measurements of a variety of physical parameters related to channel configuration and substrate composition. The various habitat units (e.g., riffles, runs, and pools) present at each site were identified and delineated as described in Overton et al. (1997). In addition to the habitat measurements, the IDEQ Stream Habitat Index (SHI) was also calculated at each site. The SHI was developed by the IDEQ specifically for small Idaho streams (Fore and Bollman 2002), and measures habitat variables in the field by assigning each a score from 0 to 9. Variables assessed include instream cover, amount of large organic debris, percent fines, embeddedness, number of pebble size categories, channel shape, percent bank vegetation cover, percent canopy cover, amount of disruptive pressures, and zone of influence. The SHI is calculated as the sum of the scored metrics and can be used to determine aquatic life use support. Additional detail on the methodology for the aquatic habitat surveys is provided in GEI (2012).

Habitat complexity at some sites near the Study Area was limited, with run habitat predominating at all sites surveyed (**Figure 3.7-1**) in the GEI (2012) baseline study. Pool habitat was present at all sites except for Site UT-1. Riffles were present at the Angus Creek sites and have been reported at the Blackfoot River sites. Observations of Site BFR-1 and Site BFR-2 in 2009 indicated that riffle habitat was more abundant at Site BFR-2, while Site BFR-1 was predominately composed of run habitat. The Angus Creek sites are observed to have the most diverse habitat types of the sites surveyed. Of the tributary sites, Site LC-1 was considerably deeper and wider than the other sites. A substantial percentage of the banks at sites LC-2 and AC-2 were observed to be eroding, and severe bank erosion was noted on the Blackfoot River upstream of the Angus Creek confluence. Bank vegetation throughout this area was composed of grasses, sedges, and willows. The use of the surrounding land for livestock grazing was evident at the sites on Lanes Creek and the unnamed tributary.

No Name Creek sites were dominated by fast-water habitat types such as runs and low-gradient riffles (GEI 2015). Pool habitat within No Name Creek was less frequent. Fast water habitat types, such as riffles and runs, were observed at both South Fork Sheep Creek sites during the May and September 2014 sampling events, and this type of habitat was abundant at Site BSRD-1 in both seasons and at Site BSRD-2 in September (GEI 2015). Stream habitat at all Sheep Creek sites in both seasons was dominated by fast-water habitat types, such as low-gradient riffles or runs, and low-gradient riffle habitat was the only habitat type present at the most upstream site in May 2014 (GEI 2015). A scour pool was present at this site in September 2014, and one or more scour pools were present at the other three sites during both surveys (GEI 2015).

The substrate was similar at most study sites, with fine substrates such as silt predominating. The substrate composition at all sites surveyed (other than Site AC-2) exhibited percent fines of 79 percent or higher. While fine substrates were still dominant at Site AC-2, this site also had a substantial amount of gravel present. Gravel comprised a major portion of the substrate at the Blackfoot River sites, but finer substrates predominated at Site BFR-1. Cobble was observed to be abundant at Site BFR-2 in 2009. Based on the Wolman pebble counts conducted in the riffle or run habitat at each No Name Creek site, substrate at sites BNNC-3 and BNNC-2 was dominated by small gravel or gravel, while substrate at Site BNNC 4 consisted entirely of fines during both sampling events (GEI 2015). Substrate within the riffle or run habitat used for the pebble counts was dominated by fines at Site BSRD-2 in September, with fines and gravel being present in equal amounts in May (GEI 2015). At Site BSRD-1, gravel was the most abundant substrate size in May 2014, while gravel and fines were present in similar amounts in September 2014 (GEI 2015). Fines, small gravel, small cobble, and cobble were also observed at all sites, while small boulders and boulders were only observed at the two sites bracketing the South Fork Sheep Creek confluence in May 2014 (GEI 2015).

The high amount of fine substrates and lack of habitat diversity at most sites near the Study Area may be a limiting factor for the resident aquatic populations. SHI scores for the No Name Creek sites increased from upstream to downstream in May 2014, ranging from 37 at Site BNNC-4 (the most upstream site), to 61 at Site BNNC-2 (GEI 2015). SHI scores for South Fork Sheep Creek in 2014 varied from 44 at Site BSRD-2 in September 2014 to 66 at Site BSRD-1 in September 2014 (GEI 2015). SHI scores for the Sheep Creek sites in 2014 ranged from 43 at Site BSC-1 in May 2014 to 68 at Site BSC-3 in May 2014 (GEI 2015). The scores for the two downstream sites in both sampling events and Site BSC-4 (in May only) were below the 10th percentile of reference condition, indicating poor aquatic habitat (GEI 2015). The 2009 study sites had SHI scores below 58, which is in the 10th percentile of reference condition for the Northern Rockies ecoregion, indicating that habitat is poor at these sites (GEI 2012).

3.7.1.1 Aquatic Influence Zone

The aquatic influence zone (AIZ) is one of many management prescriptions outlined in the CNF RFP (USFS 2003). Each prescription embodies a set of management practices for a specific land area aimed at obtaining specific land use goals. The AIZ is the area associated with lakes, reservoirs, ponds, perennial and intermittent streams, and wetlands, which directly affects the hydrologic, geomorphic, and ecological processes controlling aquatic and riparian ecosystem health and function. Specifically, these zones provide a high level of aquatic protection, help to maintain ecological functions, and provide habitat or habitat support for aquatic and riparian-dependent organisms.

AIZ widths are defined according to the guidance provided in the CNF RFP (USFS 2003) as follows:

1. <u>Fish-bearing streams</u>: AIZs consist of the stream and whichever of the following parameters is greatest:
    - Either side of the stream extending from the edges of the active stream channel to the top of the inner gorge or the outer edges of the riparian vegetation
    - A distance equal to the height of two site-potential trees
    - 300 feet slope distance (600 feet, including both sides of the stream channel)

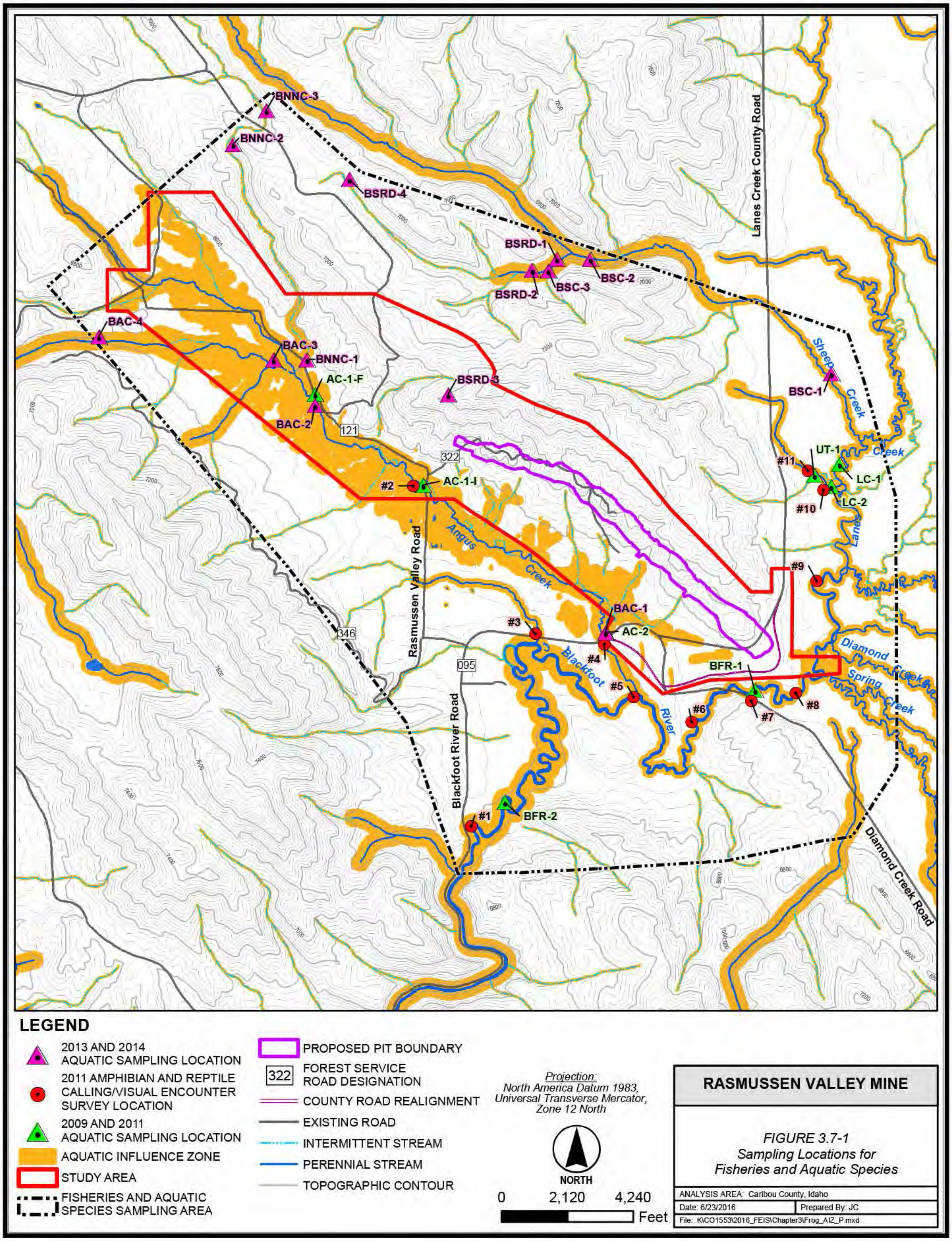
BNNC-3
BNNC-2
BSRD-4
BSRD-1
BSRD-2
BSC-3
BSC-2
BAC-4
BAC-3
BNNC-1
AC-1-F
BAC-2
BSRD-3
121
322
#2
AC-1-I
Lanes Creek County Road
Sheep Creek
BSC-1
UT-1
#11
LC-1
LC-2
#10
Lanes Creek
#9
Angus Creek
Rasmussen Valley Road
346
BAC-1
AC-2
#3
#4
095
Blackfoot River
#5
BFR-1
#6
#7
#8
Diamond Creek
Spring Creek
Blackfoot River Road
#1
BFR-2
Diamond Creek Road
LEGEND
2013 AND 2014 AQUATIC SAMPLING LOCATION
2011 AMPHIBIAN AND REPTILE CALLING/VISUAL ENCOUNTER SURVEY LOCATION
2009 AND 2011 AQUATIC SAMPLING LOCATION
AQUATIC INFLUENCE ZONE
STUDY AREA
FISHERIES AND AQUATIC SPECIES SAMPLING AREA
PROPOSED PIT BOUNDARY
322 FOREST SERVICE ROAD DESIGNATION
COUNTY ROAD REALIGNMENT
EXISTING ROAD
INTERMITTENT STREAM
PERENNIAL STREAM
TOPOGRAPHIC CONTOUR
Projection:
North America Datum 1983,
Universal Transverse Mercator,
Zone 12 North
NORTH
0 2,120 4,240
Feet
RASMUSSEN VALLEY MINE
FIGURE 3.7-1
Sampling Locations for
Fisheries and Aquatic Species
ANALYSIS AREA: Caribou County, Idaho
Date: 6/23/2016
Prepared By: JC
File: K:\CO1553\2016_FEIS\Chapter3\Frog_AIZ_P.mxd

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Table 3.7-1 Locations and Survey Activities for Monitoring Sites on the Blackfoot River, Lanes Creek, the Unnamed Tributary, Angus Creek, No Name Creek, Sheep Creek, and South Fork Sheep Creek

Site	Start Location (NAD83 Decimal Degrees)	Survey Activities	Date
Blackfoot River			
BFR-1	N42.824 W111.320	Invertebrate Populations, Amphibians, and Reptiles	August 2009
		Fish Tissues, Amphibians, and Reptiles	September 2009
		Amphibians and Reptiles	June 2011
		Invertebrate Tissues	August 2011
BFR-2	N42.814 W111.350	Invertebrate Populations, Amphibians, and Reptiles	August 2009
		Fish Tissues, Amphibians, and Reptiles	September 2009
		Amphibians and Reptiles	June 2011
		Invertebrate Tissues	August 2011
BFR-LSC	N42.814 W111.350	Northern Leatherside Chub Survey	August 2011
Lanes Creek			
LC-1	N42.844 W111.310	Invertebrate Populations, Amphibians, and Reptiles	August 2009
		Amphibians and Reptiles	September 2009
		Amphibians and Reptiles	June 2011
		Invertebrate Tissues, IDEQ Habitat	August 2011
LC-2	N42.842 W111.311	Invertebrate Populations, Amphibians, and Reptiles	August 2009
		Fish Populations and Tissues, Amphibians and Reptiles, Standard Habitat	September 2009
		Amphibians and Reptiles	June 2011
		Invertebrate Tissues, IDEQ Habitat	August 2011
LC-LSC	N42.835 W111.309	Northern Leatherside Chub Survey	August 2011
Unnamed Tributary			
UT-1	N42.843 W111.313	Invertebrate Populations, Amphibians, and Reptiles	August 2009
		Fish Populations and Tissues, Amphibians, and Reptiles, Standard Habitat	September 2009
		Amphibians and Reptiles	June 2011
		Invertebrate Tissues, IDEQ Habitat	August 2011
UT-LSC	N42.843 W111.610	Northern Leatherside Chub Survey	August 2011
Angus Creek			
AC-1-I	N42.842 W111.360	Invertebrate Populations, Amphibians, and Reptiles	August 2009
		Amphibians and Reptiles	June 2011
AC-1-F	N42.850 W111.373	Fish Populations and Tissues, Amphibians and Reptiles, Standard Habitat	September 2009
		Invertebrate Tissues, IDEQ Habitat	August 2011
AC-2	N42.829 W111.338	Invertebrate Populations, Amphibians, and Reptiles	August 2009
		Fish Populations and Tissues, Amphibians and Reptiles, Standard Habitat	September 2009
		Amphibians and Reptiles	June 2011
		Invertebrate Tissues, IDEQ Habitat	August 2011
AC-LSC	N42.824 W111.334	Northern Leatherside Chub Survey	August 2011
BAC-4	N42.855 W111.399	Fish and Invertebrate Populations, Invertebrate Tissue, IDEQ Habitat	May 2014
		Fish and Invertebrate Populations/Tissue, IDEQ Habitat, Amphibians, and Reptiles	September 2014

Table 3.7-1 Locations and Survey Activities for Monitoring Sites on the Blackfoot River, Lanes Creek, the Unnamed Tributary, Angus Creek, No Name Creek, Sheep Creek, and South Fork Sheep Creek

Site	Start Location (NAD83 Decimal Degrees)	Survey Activities	Date
BAC-3	N42.853 W111.378	Fish and Invertebrate Populations, Invertebrate Tissue, IDEQ Habitat	May 2014
		Fish and Invertebrate Populations/Tissue, IDEQ Habitat, Amphibians, and Reptiles	September 2014
BAC-2	N42.849 W111.373	Fish and Invertebrate Populations, Invertebrate Tissue, IDEQ Habitat	May 2014
BAC-1	N42.829 W111.338	Fish and Invertebrate Populations/Tissue, IDEQ Habitat, Amphibians, and Reptiles	September 2014
No Name Creek			
BNNC-4	N42.887 W111.393	Invertebrate Population and Tissue, IDEQ Habitat	May 2014
		Invertebrate Population, IDEQ Habitat, Amphibians, and Reptiles	September 2014
BNNC-3	N42.875 W111.379	Invertebrate Population and Tissue, IDEQ Habitat	May 2014
		Invertebrate Population, IDEQ Habitat, Amphibians, and Reptiles	September 2014
BNNC-2	N42.872 W111.383	Invertebrate Population and Tissue, IDEQ Habitat	May 2014
		Invertebrate Population, Periphyton Tissue, IDEQ Habitat, Amphibians, and Reptiles	September 2014
BNNC-1	N42.853 W111.374	No Surveys Performed Because of Dry Habitat	May, September 2014
Sheep Creek			
BSC-4	N42.899 W111.398	Fish and Invertebrate Populations/Tissue, IDEQ Habitat	May 2014
		Fish and Invertebrate Populations/Tissue, IDEQ Habitat, Amphibians, and Reptiles	September 2014
BSC-3	N42.861 W111.345	Fish and Invertebrate Populations/Tissue, IDEQ Habitat	May 2014
		Fish and Invertebrate Populations/Tissue, IDEQ Habitat, Amphibians, and Reptiles	September 2014
BSC-2	N42.862 W111.340	Fish and Invertebrate Populations/Tissue, IDEQ Habitat	May 2014
		Fish and Invertebrate Populations/Tissue, IDEQ Habitat, Amphibians, and Reptiles	September 2014
BSC-1	N42.852 W111.311	Fish and Invertebrate Populations/Tissue, IDEQ Habitat	May 2014
		Fish and Invertebrate Populations/Tissue, IDEQ Habitat, Amphibians, and Reptiles	September 2014
South Fork Sheep Creek			
BSRD-4	N42.869 W111.369	Amphibians and Reptiles Benthic Population/Tissue	September 2014 June 2013
BSRD-3	N42.850 W111.357	Amphibians and Reptiles Benthic Population/Tissue	September 2014 June 2013
BSRD-2	N42.861 W111.347	Fish and Invertebrate Populations/Tissue, IDEQ Habitat	June, September 2013
		Fish and Invertebrate Population, Benthic Tissue, IDEQ Habitat	May 2014

Table 3.7-1 Locations and Survey Activities for Monitoring Sites on the Blackfoot River, Lanes Creek, the Unnamed Tributary, Angus Creek, No Name Creek, Sheep Creek, and South Fork Sheep Creek

Site	Start Location (NAD83 Decimal Degrees)	Survey Activities	Date
		Fish and Invertebrate Population, Invertebrate and Periphyton Tissue, IDEQ Habitat, Amphibians, and Reptiles	September 2014
BSRD-1	N42.862 W111.344	Fish and Invertebrate Populations/Tissue, IDEQ Habitat	June, September 2013
		Fish and Invertebrate Population, Invertebrate Tissue, IDEQ Habitat	May 2014
		Fish and Invertebrate Population, Invertebrate and Periphyton Tissue, IDEQ Habitat, Amphibians, and Reptiles	September 2014

Source: GEI 2012, 2015

2. <u>All other permanently flowing streams</u>: AIZs consist of the stream and whichever of the following parameters is greatest:
   - Either side of the stream extending from the edges of the active stream channel to the top of the inner gorge
   - Outer edges of the 100-year flood plain
   - Outer edges of riparian vegetation
   - A distance equal to the height of one site-potential tree
   - 150 feet slope distance (300 feet, including both sides of the stream channel)
3. <u>Ponds, lakes, reservoirs, and wetlands larger than 1 acre</u>: AIZs consist of the body of water or wetland and whichever of the following parameters encompasses the most area:
   - Outer edges of the riparian vegetation
   - Extent of the seasonally saturated soil
   - A distance equal to the height of one site-potential tree
   - Slope distance of 50 feet from the maximum pool elevation of the wetland, pond, or lake
4. <u>Seasonally flowing or intermittent streams, wetlands smaller than 1 acre</u>: This category includes features with high variability in size and site-specific characteristics. Small wetlands can be scattered across the landscape and may not have any direct connectivity with a channel system or permanent body of water. At a minimum, the AIZs must include the intermittent stream channel or small wetland and whichever of the following parameters encompasses the most area:
   - Top of the inner gorge
   - Outer edges of the riparian vegetation

- From the edges of the stream channel or wetland to a distance equal to one half the height of site-potential tree, or 50 feet slope distance

The extent of the AIZ within the Study Area has been mapped based on existing USFS data (perennial and intermittent streams) and project-collected data (wetlands), and is shown on **Figure 3.7-1**. There are 845 acres of AIZ within the Study Area.

3.7.2 Macroinvertebrate Populations

Benthic macroinvertebrates are considered indicators of aquatic ecosystem health (USEPA 2011a). Benthic macroinvertebrate populations were sampled quantitatively and qualitatively from the sites on the Blackfoot River, Lanes Creek, the unnamed tributary, and Angus Creek by GEI personnel on August 5, 2009. GEI personnel sampled No Name Creek, Angus Creek, South Fork Sheep Creek, and Sheep Creek sample areas during May and September 2014. Surveys were also conducted within South Fork Sheep Creek during June and September 2013. Detailed methodology for macroinvertebrate data collection is provided in GEI (2012, 2015). **Table 3.7-2** summarizes the metrics calculated by GEI from the results of the macroinvertebrate population sampling.

Table 3.7-2 Macroinvertebrate Metrics Calculated for Streams in the Sampling Area

Metric	Range of Values	Explanation of Metric
Shannon-Weaver Diversity Index (H’)	0 to 4	Values greater than 2.5 indicate a healthy benthic macroinvertebrate community. Values less than 1.0 indicate a stream community under severe stress.
Percent EPT (Ephemeroptera [mayfly]-Plecoptera [stonefly]-Trichoptera [caddisfly]) taxa	0 to 100	These insect groups are considered sensitive to a wide range of pollutants and are indicators of water quality. Stress to aquatic systems can be evaluated by comparing the number and percent of EPT taxa.
Percent density of Ephemeroptera	0 to 100	Ephemeroptera taxa are considered relatively more sensitive to metals.
IDEQ Stream Macroinvertebrate Index (SMI)	0 to 100	This index allows comparison to regionally specific benchmarks developed to represent unimpacted or stressed streams. The score allows an evaluation of a stream’s ability to support benthic invertebrate communities. The SMI has scores ranging from 0 to 100, with 0 to 19 indicating a “Very Poor” rating, 22 to 43 indicating a “Poor” rating, 40 to 58 indicating a “Fair” rating, 59 to 79 indicating a “Good” rating, and 80 and above indicating a “Very Good” rating for the central and southern mountain region in Idaho.
IDEQ River Macroinvertebrate Index (RMI)	5 to 23	This index allows comparison to regionally specific benchmarks developed to represent unimpacted or stressed rivers. The score allows an evaluation of a river’s ability to support benthic invertebrate communities. Scores from 16 to 23 indicate a “Good” rating.

Source: GEI 2012

Macroinvertebrate sampling conducted in streams near the Study Area in 2009 documented 183 total taxa, representing 15 orders of macroinvertebrates collected from sites on the Blackfoot River, Lanes Creek, the unnamed tributary to Lanes Creek, and Angus Creek. Of these taxa, 17 percent were found in at least one site on all four streams, whereas 39 percent were unique to a single stream. Macroinvertebrate sampling conducted in 2013 and 2014 documented more than 220 total taxa, representing 17 orders of macroinvertebrates collected in Angus Creek, No Name Creek, Sheep Creek, and South Fork Sheep Creek.

Most macroinvertebrate metrics varied substantially among sites and streams during the 2009 surveys, with Site BFR-2 often having the highest value for many of the parameters, and sites BFR-1 and UT-1 often having the lowest values. EPT taxa represented from 13 to 32 percent of the total number of taxa collected at these sites, with ephemeropterans usually the most abundant of these groups and plecopterans absent or rare. Few differences in macroinvertebrate metrics were noted between the upstream and downstream sites on Lanes Creek, but the sites on the Blackfoot River and Angus Creek varied more, with the downstream sites on both streams exhibiting significantly higher metric values than the upstream sites for some parameters. Differences in the substrate composition, water velocities, and habitat diversity among these sites were observed, and are likely responsible for many of the differences in macroinvertebrate metrics. The site on the unnamed tributary exhibited lower values for most of the metrics than sites on other streams, but this would be expected considering that the unnamed tributary is a much smaller and shallower stream, with limited habitat complexity and availability.

Diversity index values were well above the 2.5 threshold, indicating lack of impairment at all sites surveyed near the Study Area. Additionally, SMI and RMI scores placed both the Blackfoot River sites (as well as sites LC-1 and AC-2) in the Good category, indicating that these sites support healthy macroinvertebrate communities. Sites LC-2, UT-1, and AC-1-I were categorized as Fair by their SMI scores, indicating that some factor (likely the substrate composition and other habitat parameters present at each site) may be affecting the composition of the invertebrate community. The SMI scores for sites UT-1 and AC-1-I were only marginally higher than the threshold between Fair and Poor.

During the 2013 and 2014 surveys, macroinvertebrate metrics generally varied within drainage sampling areas and with the seasons. Similar aquatic assemblages within No Name Creek were observed between the 2013 and 2014 sampling events, with the macroinvertebrate communities at most sites being dominated by true flies or aquatic segmented worms (GEI 2015). Diversity index values were below the 2.5 threshold value at BNNC-2 in September 2014, indicating potential impairment; although limited aquatic habitat was present. Similar to the scores observed in May 2014, SMI values at the No Name Creek sites in 2013 categorized sites as being in “Poor” or “Fair” biological condition. Here, the applicability of SMI is likely limited given the intermittent nature of the drainage.

Angus Creek locations BAC-1 and BAC-2 surveyed in 2013 and 2014 were in close proximity to the 2009 locations AC-2 and AC-1-I. The two additional Angus Creek locations BAC-3 and BAC-4, surveyed in 2013 and 2014, were located higher up in the watershed. Within Angus Creek, the composition of the macroinvertebrate assemblages differed somewhat among sites and seasons, but often true flies, aquatic segmented worms, or beetles were the most abundant groups (GEI 2015). SMI values categorized the Angus Creek sites as being in “Fair” or “Good” biological condition at almost all sites. Most macroinvertebrate metric values, including SMI scores, at sites downstream of the No Name Creek confluence were similar to or higher than values observed at the upstream sites in both May and September, suggesting that these assemblages were not being adversely affected by No Name Creek (GEI 2015). Aquatic segmented worms dominated the macroinvertebrate community at BSRD-2 in May and September 2014. At Site BSRD-1, true flies were the most numerically abundant group in May, while mayflies were more common in September (GEI 2015). SMI values categorized BSRD-2 as being in “Fair” biotic condition in both sampling events, while BSRD-1 was categorized as “Good” or “Very Good” (GEI 2015).

The composition of the macroinvertebrate assemblages at the two downstream sites within the perennial portion of South Fork Sheep Creek differed little between 2013 and 2014 in most respects (GEI 2015). SMI scores at the two downstream sites rated BSRD-2 as in “Poor” or “Fair” biological condition, while BSRD-1 was rated as “Good”, as it was in May 2014 (GEI 2015). The two upstream sites on South Fork Sheep Creek sampled in June 2013 (sites BSRD-4 and BSRD-3) had limited macroinvertebrate assemblages dominated by true flies. SMI values categorized both of these sites as being in “Very Poor” biological condition (GEI 2015).

At the Sheep Creek sites, the composition of the macroinvertebrate assemblages varied among sites and seasons in 2014, with mayflies, beetles, true flies, or caddisflies being the dominant group at one or more sites (GEI 2015). SMI values categorized most of the macroinvertebrate assemblages at the Sheep Creek sites as “Good”, with one site in May being characterized as “Very Good,” while one site in September was rated as “Fair”. SMI values and other metrics did not indicate any substantial change in the macroinvertebrate assemblages in Sheep Creek downstream of South Fork Sheep Creek compared to upstream (GEI 2015).

3.7.3 Fish Species

Native fish species known to occur recently or presently in the Blackfoot River and its tributaries include mountain whitefish (*Prosopium williamsoni*), Yellowstone cutthroat trout (*Onchorhynchus clarkii bouvieri*), Utah chub (*Gila atraria*), longnose dace (*Rhinichthys cataractae*), speckled dace (*Rhinichthys osculus*), redside shiner (*Richardsonius balteatus*), Utah sucker (*Catostomus ardens*), mountain sucker (*Catostomus platyrhynchus*), Paiute sculpin (*Cottus beldingii*), mottled sculpin (*Cottus bairdii*), and northern leatherside chub (*Lepidomeda copei*). Introduced species present in the watershed include the rainbow trout (*Oncorhynchus mykiss*), brook trout (*Salvelinus fontinalis*), common carp (*Cyprinus carpio*), and yellow perch (*Perca flavescens*) (IDFG 2013). Yellowstone cutthroat trout and northern leatherside chub are USFS Sensitive species and BLM Special Status species and are discussed in **Section 3.8**.

Qualitative and quantitative fish population sampling was conducted at sites LC-2, UT-1, AC-1-F, and AC-2 from September 29 to October 2, 2009 using electrofishing equipment, consistent with the IDEQ guidance and the IDFG approval (GEI 2012). Additional fish population sampling was conducted or attempted at sites BAC-1 to BAC-4 within Angus Creek, BSRD-1 and BSRD-2 within South Fork Sheep Creek, and BSC-1 to BSC-4 within Sheep Creek (GEI 2014, 2015). GEI calculated fish density and fish biomass at each sampled site, and the condition or well-being of individual fish was derived using two different indices, otherwise known as condition metrics. During these baseline surveys, GEI collected the following ten fish species from stream sites near the Study Area (GEI 2012, 2014, 2015):

- Utah chub
- Redside shiner
- Mountain sucker
- Longnose dace
- Speckled dace
- Mottled sculpin
- Paiute sculpin
- Utah sucker
- Brook trout
- Yellowstone cutthroat trout

During the 2009 fish population studies, speckled dace and mottled sculpin were collected at all sites, and Yellowstone cutthroat trout were collected at all sites except for Site BFR-2. Utah chubs and Utah suckers were collected from sites on Lanes Creek and Angus Creek and were observed on the Blackfoot River, while longnose dace were collected from the Lanes Creek site and observed on the Blackfoot River. Speckled dace were the most abundant species at most of the sites. Total fish densities and biomass were lowest at Site UT-1, likely because of the small size of this stream and the low number of species collected from this site. Total density and biomass were highest at Site AC-2, with this site also having the highest number of Yellowstone cutthroat trout collected. A direct comparison of the density and biomass at the Blackfoot River sites with the other sites could not be conducted because of differences in the methods used and the year of the sampling. However, when the population estimates for each of the tributary sites were used to determine the number of trout collected per kilometer in 2009, the Blackfoot River site appears to have exhibited a slightly higher trout density in 2008 than those observed at the other sites in 2009. Mean values for the two condition metrics evaluated for Yellowstone cutthroat trout were similar among all sites. The condition metrics for the other species were generally highest at the Angus Creek sites, indicating that fish in Angus Creek are generally in better condition than at the other sampled sites.

Based on the length-frequency analyses, Yellowstone cutthroat trout appear to be maintaining their populations through natural reproduction at sites LC-2 and AC-2. The size range of trout collected at sites UT-1 and AC-1-F was more limited than at the other sites, with all trout collected appearing to be juvenile fish. Most of the other fish species appear to be self-sustaining at the sites from which they were collected, with young and adult mottled sculpin, speckled dace, Utah suckers, and longnose dace present. Only young-of-year (YOY) and juvenile Utah chubs were collected at these sites, leading to the speculation that adult chubs may primarily reside in the Blackfoot River and use the tributaries for spawning. No northern leatherside chub were found in the Study Area during extensive surveys.

During the 2013 and 2014 fish population studies, No Name Creek study locations did not appear to support a fish population, likely because of limited habitat and intermittent flows. Within Angus Creek, seven species were collected including: Yellowstone cutthroat trout, longnose dace, mountain sucker, redside shiner, speckled dace, Utah sucker, and a sculpin species. Sculpin or speckled dace were the most abundant species collected (GEI 2015). Several large cutthroat trout in spawning condition were present at one site in May 2014, as well as juvenile trout. The size range of cutthroat trout present in September 2014 indicated that all fish were YOY or juvenile fish. Density and biomass of fish at the Angus Creek sites downstream of the No Name Creek confluence were higher than or similar to the values at the upstream sites in May and September, suggesting that no substantial changes in fish populations occurred associated with No Name Creek. Condition factor values were similar among sites in both seasons, and indicated that most fish were in average to above average condition in May 2014 (GEI 2015). Most Angus Creek sites were functioning within the 5^{th} to 25^{th} percentile range of reference conditions or higher (GEI 2015).

Within South Fork Sheep Creek, only brook trout and Yellowstone cutthroat trout were observed in low densities at the lower sample reaches during the 2013 and 2014 surveys. The two upstream South Fork Sheep Creek sites were not surveyed for fish populations in May 2014, and were dry in September 2014. Small ponds associated with these upstream reaches were also sampled for fish populations as part of the amphibian surveys; no fish were present. Likely the intermittent flows in these reaches of South Fork Sheep Creek limit fish populations from inhabiting this portion of the stream. Total SFI scores for the South Fork Sheep Creek sites indicated non-impairment and were within or greater than the 5^{th} to 25^{th} percentile range of scores for reference conditions. The size of the cutthroat trout and brook trout collected in South Fork Sheep Creek indicates that this stream reach likely does not support adult trout year-round. Instead, this portion of the stream serves as nursery habitat for young fish that would then migrate downstream into Sheep Creek or the Blackfoot River when they mature (GEI 2015).

Eight fish species were collected in Sheep Creek in 2014, including Yellowstone cutthroat trout, brook trout, longnose dace, speckled dace, mountain sucker, redside shiner, Utah sucker, and Paiute sculpin. Cutthroat trout were collected at all four sites during both sampling events, and sculpin were collected at most sites as well (GEI 2015). Adult and juvenile trout were observed in May, while YOY, juvenile, and possibly some small adults were present in September. Fish density and biomass in 2014 did not indicate any substantial changes in Sheep Creek fish populations when comparing sites upstream and downstream of the confluence of South Fork Sheep Creek. Species composition varied little among sites, and species diversity increased downstream at BSC-1. SFI scores for the Sheep Creek sites in 2014 were all within or greater than the 5th to 25th percentile range of reference condition scores (GEI 2015).

3.7.4 Amphibians and Reptiles

Project baseline surveys confirmed the presence of three species of amphibians and one snake: the northern leopard frog (*Rana pipiens*), boreal toad (*Bufo boreas*), boreal chorus frog (*Pseudacris triseriata maculata*), and common garter snake (*Thamnophis sirtalis*) (GEI 2012). The most commonly observed species was the northern leopard frog, which is an Idaho State Imperiled Species and the BLM Type 2 Sensitive Species. Northern leopard frogs were observed at two sites: BFR-1 and AC-2. The other two species observed were boreal toads (a USFS Sensitive and BLM Type 2 Sensitive Species) and boreal chorus frogs. Boreal toads were observed at site AC-2, and boreal chorus frogs were observed at site LC-2. The downstream site on Angus Creek (AC-2) was the only site from which more than one species was collected, and no amphibians or reptiles were observed at sites BR-2, LC-1, UT-1, AC-1-I, or AC-1-F during either survey period. Weather conditions during the September surveys of the sites on the Blackfoot River and Angus Creek were poor for herpetological surveys; temperatures were below freezing, and snow was present.

Frog and toad calling surveys and amphibian and reptile visual encounter surveys were conducted at 11 sites in 2011. Although three amphibian species were heard, no amphibians or reptiles were seen. The boreal chorus frog and boreal toad were the most common species heard. Several boreal chorus frogs were heard at every site, and boreal toads were heard at nine of 11 sites. In addition, a single northern leopard frog was heard at each of two sites. Stream flow during the June surveys was high because above average snowfall and snowmelt resulted in flooding of most lowland and several upland areas. These conditions created a considerable amount of temporary wetland habitat for amphibians.

Surveys in September 2014 confirmed the presence of only one amphibian species: the northern leopard frog. No amphibians were observed at any of the No Name Creek sites in September 2014. A single northern leopard frog was observed at the most downstream site on Angus Creek; no amphibians were observed at the other three sites (GEI 2015). No amphibians were observed at any of the South Fork Sheep Creek sites or the ponds associated with these sites during the fish population sampling or the visual encounter surveys in September 2014. In addition, no amphibians were observed at the sites on Sheep Creek (GEI 2015).

3.7.5 Tissue Analysis

Selenium in the environment has been identified as a concern in the Study Area because of its toxic and bioaccumulative properties, and because of its presence and solubility in mined overburden under certain conditions. Other constituents of potential concern (COPCs) for the Study Area are cadmium, lead, and mercury. Benthic macroinvertebrate and fish samples were collected to determine the baseline levels of selenium, cadmium, lead, and mercury in the aquatic environment and to assess if existing concentrations were potentially harmful to these populations. Additionally, periphyton and detrital composite samples were collected during September 2014 within No Name Creek, Angus Creek, South Fork Sheep Creek, and Sheep Creek. These samples were collected from the aquatic sampling locations shown on **Figure 3.7-1**. Concentrations were compared to studies that addressed the effects to aquatic macroinvertebrates or the effects to fish from dietary uptake of macroinvertebrates with known concentrations of cadmium, lead, mercury, and selenium (GEI 2012).

Dietary intake, rather than direct absorption from the water column, seems to be the main exposure pathway for macroinvertebrates. Bioaccumulation is difficult to quantify because it is affected by many variables. As a result, there is wide variation in the measured “bioaccumulation factor,” or the ratio of the concentration of selenium inside an organism to the concentration in the surrounding environment (Nagpal and Howell 2001). One laboratory study found that, on average, mayfly larvae accumulated 2.2 times the selenium concentration of their food source (periphyton, or algae), which had itself accumulated 1,113 times the selenium concentration of the water column (Conley et al. 2009). Other studies have reported similar bioaccumulation factors (Muscatello 2009; Ohlendorf 2003; Lemly 1999).

Periphyton and detritus samples collected at No Name Creek (BNNC-2) indicated a selenium concentration of 14.8 microgram per gram dry weight (µg/g dw). Within the Angus Creek locations, selenium concentrations for composite periphyton samples ranged from 0.2 µg/g dw (BAC-1) to 1.3 µg/g dw (estimated) at BAC-3. South Fork Sheep Creek selenium concentrations for composite periphyton samples ranged from 0.8 µg/g dw at BSRD-1 to 4.3 µg/g dw at BSRD-2. Sheep Creek selenium concentrations for composite periphyton samples ranged from 0.2 µg/g dw (estimated) at BSC-2 to 0.7 µg/g dw (estimated) at BSC-2.Within the 2009 tissue collections, macroinvertebrate tissue concentrations of COPCs at five of eight sites were not at levels that should be detrimental to the fish using them as a food resource. However, selenium concentrations at sites BFR-2, LC-2, and AC-2 were higher than the 3 µg/g dw threshold recommended by Lemly (1993) and Hamilton (2003), suggesting that selenium concentrations may be of concern to the health of the fish populations (GEI 2012).

Within the 2014 tissue collections, macroinvertebrate tissue concentrations of COPCs within No Name Creek showed cadmium concentrations ranging from 2.5 to 7.4 µg/g dw, selenium concentrations ranging from 1.8 to 8.6 µg/g dw, and zinc concentrations ranging from 69 to 263 µg/g dw. Selenium concentrations in macroinvertebrate tissues ranged from 0.8 µg/g dw at BNNC-4 in September 2013 to 7.6 µg/g dw at BNNC-3 in June 2013 (GEI 2015). These elevated concentrations may pose potential risks to higher trophic level organisms within the food web; however, based on limited habitat and intermittent flow conditions, direct consumption by fish is unlikely.

Macroinvertebrates were collected for tissue analysis from each Angus Creek site in both May and September 2014. Concentrations of many metals were similar among sites between the two seasons. Selenium concentrations ranged from 0.6 µg/g dw at BAC-3 in September 2014 to 1.7 µg/g dw at BAC-1 in May 2014 (GEI 2015). Concentrations of cadmium ranged from 0.1 µg/g dw at BAC-4 in September 2014 to 0.86 µg/g dw at BAC-3 in May 2014. Zinc concentrations ranged from 10.9 µg/g dw at BAC-4 in September 2014 to 48.2 µg/g dw at BAC-3 in May 2014. These COPC macroinvertebrate concentrations observed in Angus Creek likely pose low potential risks to higher trophic level organisms within the food web.

Selenium concentrations in macroinvertebrate tissues in South Fork Sheep Creek ranged from 3.9 µg/g dw at BSRD-1 in September 2014 to 7.1 µg/g dw at BSRD-2 in May 2014 (GEI 2015).

Selenium concentrations were slightly higher in May compared to September at both sites, as were cadmium and zinc concentrations (GEI 2015). Concentrations of cadmium ranged from 0.49 µg/g dw at BSRD-2 in September 2014 to 0.87 µg/g dw at BSRD-2 in May 2014. Zinc concentrations ranged from 50 µg/g dw at BSRD-2 in September 2014 to 111 µg/g dw at BSRD-1 in May 2014. Selenium concentrations ranged from 3.8 µg/g dw at BSRD-1 in June 2013 to 55.5 µg/g dw at BSRD-4 in June 2013 (GEI 2015). These COPC macroinvertebrate concentrations observed in South Fork Sheep Creek likely pose low to moderate potential risks to higher trophic level organisms within the food web.

Selenium concentrations in macroinvertebrate tissues collected in Sheep Creek during 2014 were low, ranging from 0.5 µg/g dw at BSC-3 in September 2014 to 1.5 µg/g dw at BSC-1 during the same sampling event (GEI 2015). Concentrations of cadmium ranged from 0.06 µg/g dw at BSC-3 in September 2014 to 0.76 µg/g dw at BSC-4 in May 2014. Zinc concentrations ranged from 30 µg/g dw at BSC-4 in September 2014 to 83 µg/g dw at BSC-2 in May 2014. These COPC macroinvertebrate concentrations observed in Sheep Creek likely do not pose risks to higher trophic level organisms within the food web.

The USEPA recently released draft aquatic life chronic criteria for selenium in freshwater systems, which include criteria based on two media: fish tissue and the water column (USEPA 2015a). The draft fish tissue criteria for selenium are 15.8 µg/g dw for egg/ovary tissue, 8.0 µg/g dw for whole body, and 11.3 µg/g dw for muscle tissue. Of these, the whole-body criterion of 8.0 µg/g dw is comparable to baseline fish tissue data collected in the fisheries and aquatic resources sampling area (**Figure 3.7-1**). It should be noted that these are draft criteria and therefore subject to change, but these criteria provide a frame of reference for evaluating concentrations of selenium in the sampling area.

There is uncertainty in the applicability of the USEPA (2015a) whole-body fish tissue chronic criterion because this value is driven down by the bluegill as a more sensitive warm-water fish species. This draft value is also in question, as the USEPA evaluates technical comments and potential issuing of a final standard.

Depending on dosage and exposure, selenium is toxic to fish and highly bioaccumulative in aquatic food chains (Ohlendorf 2003). Selenium bioaccumulation factors reported for fish in field studies range from 273 to 6,538 (the selenium concentration in fish ranges from 273 to 6,538 times the concentration in water), with an average of 1,900 (Muscatello 2009; USEPA 2004; Lemly 1999).

Geometric mean whole-body selenium values for all fish species collected in 2009 ranged from 5.0 µg/g dw (in mottled sculpin at site UT-1) to 16.1 µg/g dw (in mottled sculpin at site BFR-2). Selenium concentrations were generally lowest in Yellowstone cutthroat trout and highest in mottled sculpin. When all fish selenium data were pooled for each site, statistical analyses indicated that selenium concentrations were significantly higher in fish from Site BFR-1 and BFR-2 than in fish from the other sites ($p < 0.01$). The only deformities observed in fish from these sites that could be related to selenium toxicity were shortening of the operculum of some trout. Some effects, if present, may not be physically visible, such as reproductive effects. However, cutthroat trout densities were generally low, and no trout were observed at the downstream Blackfoot River site in 2009 (GEI 2012).

Geometric mean selenium values for all fish species collected in 2013 and 2014 ranged from 0.8 µg/g dw at BSC-3 in September 2014 to 10.9 µg/g dw at BSRD-2 in September 2013. In Angus Creek individual whole-body trout tissue concentrations of selenium ranged from 1.3 µg/g dw at

BAC-3 to 2.2 µg/g dw at BAC-1 in September 2014. Sculpin tissue concentrations of selenium were similar to trout and ranged from 1.0 µg/g dw at BAC-3 to 2.4 µg/g dw at BAC-2 in September 2014. Speckled dace collected at BAC-1 indicated the highest selenium concentrations, ranging from 2.0 to 4.1 µg/g dw in September 2014. The geometric mean of selenium tissue concentrations in whole-body trout fish tissues was lower at BSRD-1 than Site BSRD-2 during both events, and ranged from 2.8 µg/g dw at Site BSRD-1 in June 2013 to 10.9 µg/g dw at Site BSRD-2 in September 2013 (GEI 2014). Cutthroat trout and sculpin collected in Sheep Creek indicated lower geometric mean selenium concentrations, than the South Fork Sheep Creek fish, ranging from 0.8 µg/g dw at BSC-3 to 1.7 µg/g dw at BSC-2 in September 2014. In general, most whole-body fish tissue concentrations of selenium found within these tributaries were below the proposed threshold value of 8.0 µg/g dw. High selenium concentrations have been shown to cause deformities of larval fish and mortality of fish in all life stages (Ohlendorf 2003; Lemly 1999; Lemly 1997). Using a compilation of field and laboratory data, Lemly (1997) described the relationships among whole-body selenium concentrations in fish populations, percentage of deformities, and percentage of associated mortalities. According to Lemly's data, there is an exponential relationship between whole-body selenium concentration and percentage of deformed fish in a population, with the effects being more severe for larvae and fry than for juveniles and adults.

The existing effects on the surveyed fish communities in Angus Creek during 2009 only indicated one potential deformity associated with selenium at AC-2 for a cutthroat trout. Mean relative weights (Wr) and condition factor were not optimal (Wr less than 95 percent and condition factor below 1.0) for cutthroat trout at the Angus Creek locations. However, during 2014 fish population studies in Angus Creek, condition factors for cutthroat trout in May indicated average to above average condition, with slightly below average condition in September (GEI 2015). The 2014 fish population studies in Angus Creek indicated only two potential deformities for a sculpin with a spinal anomaly and a cutthroat trout with a shortened operculum; resulting in an overall index of 1.2 or less, well below the 20 percent rate of occurrence that would be anticipated to have a negligible impact on fish populations (Lemly 1997).

Concentrations of cadmium, lead, and mercury in fish tissues collected from study sites were consistently low, with all concentrations falling below the screening levels, maximum allowable concentrations, and criteria set for these metals. These results indicate that these metals are not likely currently limiting fish populations at the sample sites, and that the risk to human health from these metals through fish consumption from these streams is currently negligible.

3.8 THREATENED, ENDANGERED, OR SENSITIVE SPECIES

3.8.1 Threatened, Endangered, Proposed, and Candidate Species

Based on review of information available on the USFWS Information for Planning and Conservation (IPaC) website (USFWS 2016), Canada lynx (*Lynx canadensis*) and North American wolverine (*Gulo gulo luscus*) are currently the only federally listed species with potential to occur in Caribou County, Idaho and therefore the Study Area. Detailed accounts of Canada lynx and North American wolverine are provided in the Biological Assessment (BA) (BLM and USFS 2016). A summary of the affected environment for the species is provided below.

3.8.1.1 Canada Lynx

The Canada lynx is a predator of the northern boreal forest, including portions of the Rocky Mountains and Cascade Mountains. The historical range of the Canada lynx extended from

Alaska across much of Canada, with southern extensions into parts of the western U.S., the Great Lakes states, and New England (McKelvey et al. 1999; Ruediger et al. 2000). The USFWS listed the Canada lynx as Threatened under the Endangered Species Act of 1973 (ESA) in the contiguous U.S. in March 2000 (USFWS 2000).

The distribution of lynx is associated with boreal forest and closely follows that of the snowshoe hare (Ruggiero et al. 1994). Snowshoe hares are the primary prey of lynx; thus, lynx foraging habitat coincides with the dense understory shrub and sapling habitats used by snowshoe hares (Ruggiero et al. 1994). Preferred habitats include coniferous boreal forests with openings, bogs, and thickets; old growth taiga; mixed or deciduous forest; and wooded steppe. Lynx denning habitat is found in mature forests with high horizontal cover provided by coarse woody debris (Ruggiero et al. 1994; Ruediger et al. 2000). Suitable travel corridors consist of a closed canopy of coniferous or deciduous vegetation taller than 6 feet. Lynx avoid large openings where they cannot stalk their prey or stay hidden from larger predators (Ruggiero et al. 1994).

Lynx populations persist in a boreal forested landscape that contains large, contiguous patches of suitable habitat (home ranges reportedly range from 31 to 216 square km [12 to 83 miles]). At the landscape scale, suitable lynx habitat must consist of appropriate forest types (including a mixture of early to late-successional forests), areas with deep snow (which excludes many competitors), and high snowshoe hare densities. Lynx are also highly mobile and have a propensity to disperse long distances, particularly when prey becomes scarce; they can make long-distance exploratory movements outside their home ranges (Interagency Lynx Biology Team 2013; USFWS 2005). Linkage areas are habitat corridors that facilitate these exploratory movements and are also important for dispersal and breeding season movements. Note that linkage areas may encompass areas of non-lynx habitat (Interagency Lynx Biology Team 2013).

As previously described, the Canada lynx is listed as potentially occurring in Caribou County (USFWS 2016). There is no critical habitat (USFWS 2014) and there is no suitable denning habitat (TRC 2012a, 2012c) for Canada lynx in the Study Area. Project-level surveys of the Study Area indicate that lynx use thereof, if any, is limited to occasional use by individuals dispersing among more suitable habitat patches. Figure 1-1 of the Northern Rockies Lynx Management Direction EIS (USFS 2007) corroborates this and shows the project location as occurring in potential lynx linkage habitat.

TRC conducted winter track surveys in the Study Area three times between February 26 and April 11, 2010, and three times between February 27 and March 25, 2012, to evaluate use of the Study Area by large mammals, including lynx (TRC 2012a, 2012c); biologists did not observe any Canada lynx or signs thereof. In 2005, a female Canada lynx and two cubs were spotted 15 miles northeast of Soda Springs in Caribou County (BLM 2013). The USFS and BLM met with the USFWS on July 19, 2013 for another mining project effort and agreed that the aforementioned lynx observations were likely part of a Colorado reintroduction program that began circa 2000 (BLM 2013). Several lynx associated with the reintroduction effort returned northward; occasionally passing through the CTNF. Other than the family observed in 2005, no other reintroduced lynx have been reported on the Soda Springs or Montpelier Ranger Districts (BLM 2013).

Annual winter tracking surveys conducted by the USFS from 2003 to 2013 to monitor carnivore presence in the CTNF did not detect lynx (BLM 2013). The FEIS for the CNF RFP (USFS 2003) states that there the paucity of historical lynx occurrence records suggests that there has never been a viable population of lynx in the forest. The CNF RFP also states that no lynx hair samples had been identified during lynx hair snare grid surveys on the CNF (USFS 2003). Finally, review of the Idaho Fish and Wildlife Information System (IFWIS) website (2016) indicates that there have been historical lynx sightings in Caribou County; however, public wildlife and plant observations records available for review on the website indicate that there have been no recent public lynx observations in Caribou County (IFWIS 2016).

Based on the aforementioned habitat information and survey data/observation information, Canada lynx occurrence in the Study Area is expected to be limited, if any, to transient use of linkage habitat.

3.8.1.2 North American Wolverine

The North American wolverine is proposed for federal listing under the ESA as a threatened species and is also a USFS Sensitive Species. Wolverines prefer large contiguous tracts of coniferous forest habitat and tend to avoid grasslands and shrublands (Copeland et al. 2007, Copeland 1996). A study in central Idaho found that wolverines prefer elevations above 7,200 feet (Copeland et al. 2007). In Idaho, natal den sites occur above 8,200 feet (USFWS 2010). Wolverines use talus slopes as denning sites, and talus is considered a special denning habitat component for this species (USFWS 2010). Individual wolverines may possibly occur in the Study Area. However, the forests in the Study Area are naturally patchy and are at lower elevations than what wolverines prefer. There is no potential for denning because the Study Area is located below 8,200 feet and lacks talus slopes that could provide denning habitat. No wolverine tracks were observed in the Study Area during baseline wildlife surveys (TRC 2012a, c). However, individual wolverines may intermittently travel through patchy forests in the Study Area based on verified observations of wolverines in Caribou County in the vicinity of the Study Area (IDFG 2014).

Although wolverines are known to occur in Caribou County (IDFG 2014), the lack of individual wolverine or track observations during baseline surveys (TRC 2012a, c) in conjunction with a lack of denning habitat indicate that RCA impacts would likely be limited to individual wolverines that may occasionally travel through the area.

3.8.2 USFS Sensitive and Management Indicator Species and BLM Sensitive Wildlife Species

The Regional Forester identifies Sensitive and Management Indicator Species (MIS). Sensitive Species are identified as those for which population viability in the region is a concern as indicated by current or predicted downward trends in population numbers, density, or habitat capability. Sensitive Species receive special management emphasis to ensure their viability and to prevent the need for listing of the species as Threatened, Endangered, and Proposed Candidate Species. The BLM also recognizes Sensitive Species as those that are range-wide or globally imperiled, regionally or state imperiled, or peripheral species (species that are generally rare in Idaho, with the majority of their breeding range outside the state).

MIS are species that are sensitive to habitat changes that the USFS designates as indicators of the health of habitats. The CTNF recognizes greater sage-grouse as an MIS for sagebrush habitats and Columbian sharp-tailed grouse as an MIS for grassland and open-canopy sagebrush habitats. It also recognizes the northern goshawk as an MIS for mature and old-forest habitats.

Greater sage-grouse was previously a candidate for listing under status review by the USFWS and was therefore previously included in **Section 3.8.1** of the Draft EIS. Since the time of the Draft EIS, the species has been precluded from listing. Because of the large amount of information already amassed for the greater sage-grouse, it is described separately from other species in this section. **Table 3.8-1** identifies all other MIS and Sensitive Species that occur or potentially occur in the Study Area. In addition to identifying the species, the table summarizes the species' habitat preferences and the known or likely potential for occurrence.

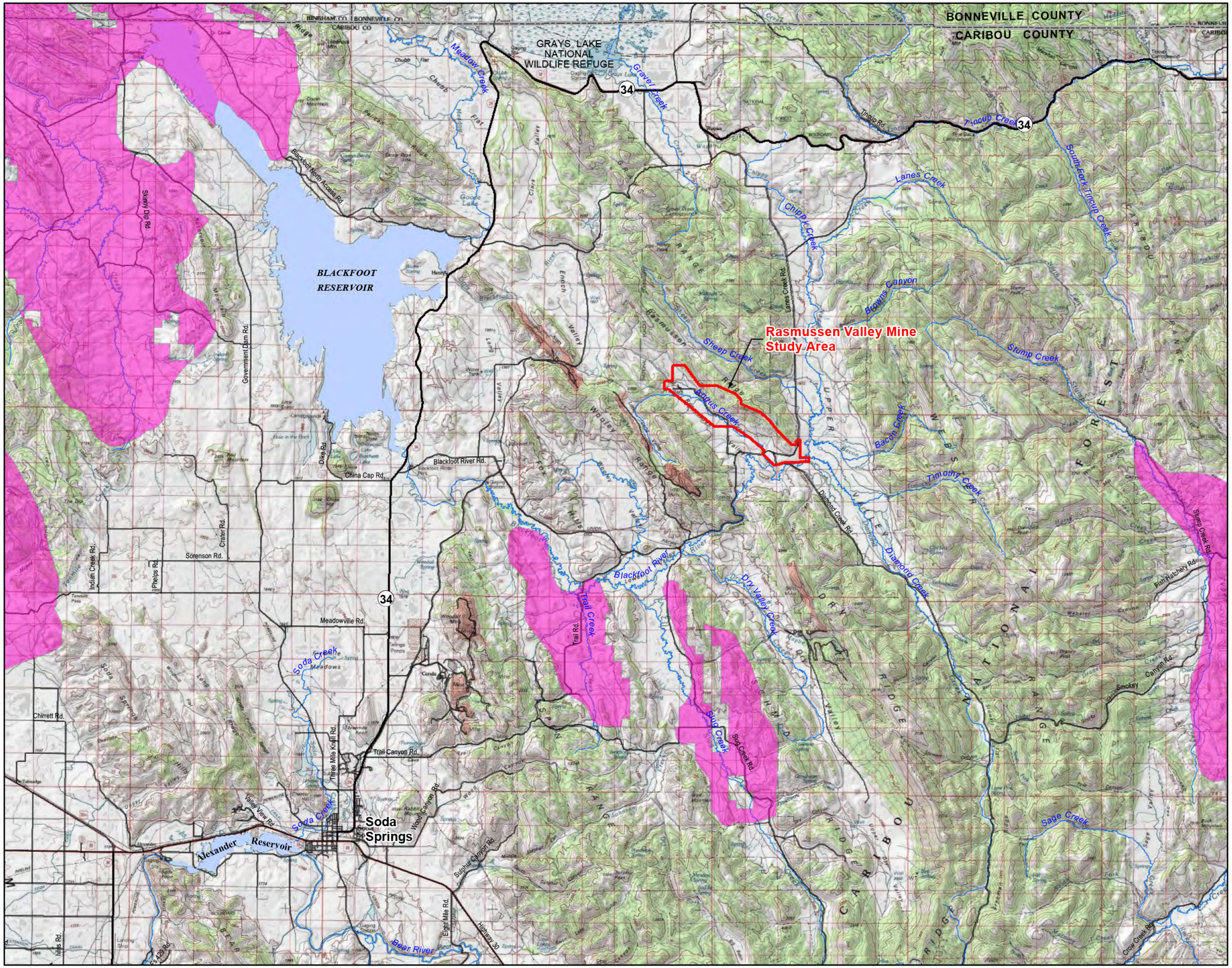
3.8.2.1 Greater Sage-Grouse

The greater sage-grouse was a candidate for listing under status review by the USFWS. On October 2, 2015, the USFWS announced a 12-month finding on petitions to list the species, both range-wide and for the Columbian Basin population, as Endangered or Threatened species under the ESA. After review of best available scientific literature and commercial information, the USFWS found that the Columbia Basin population does not qualify as a distinct population segment, and that listing of the greater sage-grouse is not warranted at this time. The greater sage-grouse is, however, currently a BLM and USFS Sensitive Species, a USFS MIS for sagebrush habitats, and a state-protected game bird managed in accordance with the 2006 Conservation Plan for the Greater Sage-grouse in Idaho (Idaho Sage-grouse Advisory Committee 2006).

In August 2011, the BLM convened the Sage-Grouse National Technical Team (NTT), which developed a series of science-based conservation measures for greater sage-grouse to be considered and analyzed through the land use planning process. As a result of meeting and coordination, the NTT released A Report on National Greater Sage-Grouse Conservation Measures (NTT 2011). On December 27, 2011, the BLM released two Instructional Memoranda (IM 2012-043 and IM 2012-044) that provide direction to the BLM on how to consider the NTT conservation measures in the land use planning process and that provide interim management policies and procedures for greater sage-grouse.

In September 2015, the BLM and USFS released an Approved Resource Management Plan Amendment (ARMPA) for managing greater sage-grouse in Idaho and southwestern Montana. The ARMPA adopts the management described in the Idaho and Southwest Montana Greater Sage-Grouse Proposed Resource Management Plan Amendment and Final EIS (BLM and USFS 2015a), with modifications and clarifications as described in the record of decision (ROD) for the ARMPA (BLM and USFS 2015b).

The ARMPA recognizes five conservation areas in Idaho and Montana: Mountain Valleys Conservation Area, Desert Conservation Area, West Owyhee Conservation Area, Southern Conservation Area, and Southwestern Montana Conservation Area. The Study Area is located in the Southern Conservation Area. Within each conservation area, the ARMPA designates greater sage-grouse habitat management areas. Priority Habitat Management Areas (PHMAs) encompass areas with the highest conservation value to greater sage-grouse, based on the presence of larger leks, habitat extent, important movement and connectivity corridors, and winter habitat. Important Habitat Management Areas (IHMAs) contain additional habitat and populations that provide a management buffer for the PHMA and connect patches of PHMA. IHMAs also encompass areas of generally moderate to high conservation value habitat and/or populations, and, in some conservation areas, include areas beyond those identified by USFWS as necessary to maintain redundant, representative, and resilient populations. General Habitat Management Areas (GHMAs) encompass habitat outside of PHMAs or IHMAs that contains 10 percent of the occupied leks that are also of relatively low male attendance compared to leks in PHMAs or IHMAs. GHMAs are generally characterized by lower quality disturbed or patchy habitat of low lek connectivity (BLM and USFS 2015b). PHMAs, IHMAs, and GHMAs were delineated based on the best available information and encompass the vast majority of known habitat and leks in the sub region; however, areas of occasional or intermittent use by greater sage-grouse were omitted (BLM and USFS 2015b). None of the aforementioned greater sage-grouse habitat management areas overlap the Study Area, as shown on **Figure 3.8-1**; the nearest management area (GHMA) occurs 5 to 6 miles to the south.



LEGEND

- STUDY AREA
- GREATER SAGE-GROUSE GENERAL HABITAT MANAGEMENT AREA (GHMA)
- COUNTY BOUNDARY
- MAJOR LAKE/RESERVOIR
- MAJOR STREAM/RIVER
- STATE ROUTE
- OTHER ROAD

Projection:
North America Datum 1983, Universal Transverse Mercator, Zone 12 North
Source:
USA Topo Maps, serviced by ESRI ArcGIS Online, accessed on 8/30/2016
Greater Sage Grouse Data, BLM 2015

NORTH

0 3.1 6.2 Miles

RASMUSSEN VALLEY MINE

FIGURE 3.8-1
BLM Sage-Grouse Habitat in the Region

ANALYSIS AREA: Caribou County, Idaho
Date: 8/30/2016 Prepared By: JC
File: K:\CO1553\2016_FEIS\Chapter3\BLM_SageGrouse.mxd

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Populations of greater sage-grouse are allied closely with sagebrush (Connelly et al. 2000). They use sagebrush for breeding, roosting, cover, and food. As Connelly et al. (2004) summarize, greater sage-grouse breeding habitats typically consist of sagebrush-dominated rangelands with extensive, relatively contiguous sagebrush stands, predominately on gentle terrain (less than 10 percent slope) and with relatively short distances to water (less than 2,000 meters). Leks (breeding display grounds) are situated in relatively open areas with less herbaceous and shrub cover than surrounding areas. Leks may be located in dry stream channels, on the edges of stock ponds, on ridges, in grassy meadows, in burned areas, in gravel pits, on sheep bedding grounds, in plowed fields, and on roads. Leks are typically adjacent to or surrounded by dense sagebrush stands, which are used for escape and feeding cover.

Nesting habitat includes sagebrush with horizontal and vertical structural diversity. Preferred understory is composed of native grasses and forbs, which provide food sources, among larger shrubs, under which nests are placed (Connelly et al. 2004). Nesting and early brood-rearing habitat, which is used in May and June, typically consists of big sagebrush communities with 15 to 25 percent canopy cover, sagebrush height of 15 to 30 inches, and a grass and forb understory (Gillan and Strand 2010). For late brood-rearing activities, which occur from July to September, greater sage-grouse prefer moist habitats including riparian areas, wet meadows, lakebeds, and uplands with sagebrush and areas that were recently burned (Gillan and Strand 2010; Stiver et al. 2010).

During winter, greater sage-grouse feed almost exclusively on sagebrush. They tend to frequent areas with a canopy cover of 10 to 30 percent sagebrush, preferably tall enough to remain at least 10 inches above the snow layer. They prefer areas with south- and southwest-facing aspects and gentle slopes (Gillan and Strand 2010).

The CNF RFP states that projects within 10 miles of an active sage-grouse lek should be considered further for suitability as sage-grouse habitat. The IDFG has records for ten leks within 10 miles of the Study Area. Three of these have a Management Status of “undetermined”, meaning that lek status has not been verified within the past 5 years. Five of the leks within 10 miles have a status of “unoccupied”, meaning that there have been 5 consecutive years of observation with no evidence of activity. This includes the closest recorded lek to the Study Area, located near Angus Creek 0.8 mile to the southwest. One lek within 10 miles has a status of “not verified.” This is a historical observation with no recent sightings on the ground or in the air, and not confirmed with a consecutive flight or ground observation by a professional. Finally, one lek within 10 miles has a status of “occupied”, meaning that two or more male grouse were observed from the ground displaying within the past 5 years. This occupied lek is located 7.8 miles southwest of the Study Area (IDFG 2015). In addition to these lek records, in 2015, a USFS employee reported sage-grouse displaying in the Blackfoot River WMA within 1 mile to the southeast of the Study Area. In 2015, sage-grouse were also heard displaying in Dry Valley, 4 miles south of the Study Area, but a visual confirmation was never obtained (IDFG 2015).

Grouse tracks were noted by TRC during the 2010 and 2012 winter track surveys; however, these tracks could not be identified to species (TRC 2012a, 2012c). Aerial surveys were conducted on April 10, 11, 21, and 22, 2011 to search for leks within the Study Area and a 3-mile buffer. No activity was observed at the Angus Creek lek, and no additional leks or sage-grouse were observed in the Study Area or 3-mile buffer (TRC 2012b). TRC also conducted an aerial survey on February 7, 2012 to evaluate sage-grouse winter use of the Study Area and 3-mile buffer. No greater sage-grouse were observed during this survey (TRC 2012c). TRC recorded incidental observations of 19 greater sage-grouse during summer 2011 wildlife surveys in the Study Area and vicinity. Two of the individuals were males, one was a juvenile, and the remaining 16 were adult females. Seventeen of the birds were observed between June 14 and 17, 2011, with a single observation of two individuals on August 5, 2011.

Given the limited dates on which greater sage-grouse were observed, and the fact that no more than three individuals ever were observed at any one time, it is possible that the observations represent repeat instances of a small group of grouse that used the Study Area briefly for foraging before moving on. No indication of breeding or nesting activity was recorded, and habitats in the Study Area are marginal for sage-grouse, as they are patchy (TRC 2012b) and do not meet the definitions of any of the USFS and BLM's (2015b) three habitat management area categories.

Table 3.8-1 USFS Sensitive and Management Indicator Species for Caribou National Forest and BLM Sensitive Species for the Pocatello Field Office

Common Name	Scientific Name	Status	Preferred Habitat[1]	Potentially Occurs in Study Area?
Pygmy rabbit	*Brachylagus idahoensis*	USFS Sensitive; BLM Sensitive	This species uses dense stands of tall sagebrush with a high amount of woody cover in areas with deep soils.	Unlikely. TRC evaluated the Study Area for suitability for pygmy rabbits in summer 2011, and determined that the Study Area lacks the preferred microhabitat characteristics (e.g., mounds or inclusions of taller, denser sagebrush, often with characteristic mounding of soil at the base of the shrubs) that would indicate potential current or past use of the area by pygmy rabbits (TRC 2012b).
Uinta chipmunk	*Tamias umbrinus*	BLM Sensitive	Found at 6,500 to 11,150 feet, in coniferous forests, often near logs and brush in open areas, and at edges of forests.	Unlikely. There is no suitable coniferous forest habitat for this species in the Study Area.
Gray wolf	*Canis lupus*	USFS Sensitive	Occurs in a wide variety of habitats; prefers landscapes with minimal human disturbance and abundant ungulate prey (NatureServe 2014). The 2014 range map for gray wolves indicates known wolf packs dispersed throughout the northern two thirds of Idaho, with a scattering of packs also recorded in the northeastern corner of eastern Idaho. The closest of the known packs (the Tex Creek pack) is 40 miles north-northwest of the Study Area (Husseman and Struthers 2015).	Unlikely but possible. No gray wolf tracks were observed in the Study Area during baseline winter track surveys (TRC 2012a, 2012c). However, an incidental observation of a possible gray wolf was recorded on top of a ridge 3 miles northwest of the Study Area during the February 2012 aerial survey for wintering grouse (TRC 2012c). This observation indicates that individual wolves may occasionally disperse through the area.
Wolverine	*Gulo gulo*	USFS Sensitive, ESA Proposed Threatened	See **Section 3.8.1.2.**	Unlikely but possible. See **Section 3.8.1.2**.

Table 3.8-1 USFS Sensitive and Management Indicator Species for Caribou National Forest and BLM Sensitive Species for the Pocatello Field Office

Common Name	Scientific Name	Status	Preferred Habitat[1]	Potentially Occurs in Study Area?
Spotted bat	*Euderma maculatum*	USFS Sensitive; BLM Sensitive	Uses a variety of habitats including ponderosa pine, desert scrub, pinyon-juniper, open pasture, and hay fields. Roosts alone in rock crevices high up on steep cliff faces. Cracks and crevices ranging in width from 0.8 to 2.2 inches in limestone and sandstone cliffs are critical roosting sites.	Unlikely. No USFS/BLM sensitive bat species were detected during the 4.5-month baseline acoustic monitoring period. The spotted bat has low intensity calls that make acoustic detection difficult. Thus, the presence or absence of this species in the Study Area cannot be fully confirmed based solely on the results of this study (Rodriguez 2012, TRC 2012b). However, the project is located outside of this species' known range in Idaho, and the Study Area lacks steep cliff faces that could provide roosting habitat.
Townsend's big-eared bat	*Corynorhinus townsendii*	USFS Sensitive; BLM Sensitive	Occupies moist forests, as well as arid savannah and shrub-steppe. It has been found foraging over sagebrush-grasslands, riparian areas, open pine forests, and arid scrub within the Greater Yellowstone Ecosystem. Caves and mines are used for both summer roosts and winter hibernacula.	Yes; the Study Area contains potentially suitable habitat for this species. No USFS/BLM sensitive bat species were detected during the 4.5-month baseline acoustic monitoring period. However, Townsend's big-eared bat has low intensity calls that make acoustic detection difficult. Thus, the presence or absence of this species in the Study Area cannot be fully confirmed based solely on the results of this study (Rodriguez 2012, TRC 2012b).
Boreal owl	*Aegolius funereus*	USFS Sensitive; BLM Sensitive	Prefers mature to old-growth Douglas-fir, mixed conifer, spruce-fir, and aspen forests. Mature forests are required for nesting, because the owls require large nesting cavities (3-inch-diameter openings and 12- to 15-inch-diameter trees). Nesting habitat structure consists of forests with a relatively high density of large trees, open understory, and multi-layered canopy.	Yes. TRC conducted three nocturnal calling surveys for the boreal owl between late February and the end of April in 2010 and 2012. One boreal owl was heard during the 2012 surveys, but no evidence of nesting was found in the area (TRC 2012c).

Table 3.8-1 USFS Sensitive and Management Indicator Species for Caribou National Forest and BLM Sensitive Species for the Pocatello Field Office

Common Name	Scientific Name	Status	Preferred Habitat[1]	Potentially Occurs in Study Area?
Flammulated owl	*Otus flammeolus*	USFS Sensitive; BLM Sensitive	Found in mixed pine forests, from pine mixed with oak and pinyon at lower elevations to pine mixed with spruce and fir at higher elevations. They have also been found in aspen and second-growth ponderosa pine; however, preferred habitat is mature ponderosa pine/Douglas-fir forests and mixed conifer forests with open canopies.	Unlikely but possible. Has been found nesting in aspen in the CNF. TRC conducted three nocturnal calling surveys for the flammulated owl between May 1 and June 30, 2010 and between May 1 and early June 2012. No flammulated owls were heard or observed during the surveys (TRC 2012a, 2012c).
Great gray owl	*Strix nebulosa*	USFS Sensitive; BLM Sensitive	Found in coniferous and hardwood forests, especially pine, spruce, paper birch, and poplar; also found in second growth, especially near water. In Idaho, found at lower elevations and in agricultural areas during winter and in conifer forests in spring and summer, most commonly near extensive meadows.	Yes. TRC conducted three nocturnal calling surveys for the great gray owl between late February and the end of April in 2010 and 2012. Great gray owls were heard during each survey in 2010, and were noted at eight locations during the 2012 surveys. No active nests were discovered during a follow-up nest survey in 2012; however, the Study Area contains suitable nesting and foraging habitat for great gray owls, and it appears that at least one and possibly two nesting territories occur within the Study Area and 0.5-mile buffer (TRC 2012a, 2012c).
Bald eagle	*Haliaeetus leucocephalis*	USFS Sensitive; BLM Sensitive	Found primarily near seacoasts, rivers, and reservoirs and lakes, where it roosts and nests in large trees.	Yes. Bald eagles are not known to nest within the Study Area or vicinity, but they were observed using the Study Area during baseline RLB surveys in 2011 (TRC 2012b) and during the during the February 7, 2012 aerial winter grouse survey (TRC 2012c).
Northern goshawk	*Accipiter gentilis*	USFS Sensitive; USFS Management Indicator Species; BLM Sensitive	Uses a variety of forest types, forest ages, structural conditions, and successional stages. Has been found nesting in Douglas-fir, mixed conifer, and lodgepole pine cover types. Suitable breeding habitat includes three components: 1) nesting areas, which typically have a relatively high tree canopy	Yes. TRC conducted diurnal calling surveys for the northern goshawk in May and June 2010 and June and July 2011. While no active northern goshawk nests were identified during these surveys, one individual northern goshawk was observed in 2010, and two individual northern goshawks were observed in 2011 (TRC

Table 3.8-1 USFS Sensitive and Management Indicator Species for Caribou National Forest and BLM Sensitive Species for the Pocatello Field Office

Common Name	Scientific Name	Status	Preferred Habitat[1]	Potentially Occurs in Study Area?
			cover, high density of large trees, and are usually mature or older forested stands; 2) post-fledging area (PFA), which surrounds the nest area and includes a variety of forest conditions, typically with well developed understory; and 3) foraging areas, which includes a greater diversity of land forms, forest cover types, and vegetation structural stages. Important habitat components include snags, downed logs, woody debris, openings, large trees, herbaceous and shrubby understories, and interspersion of vegetation structural/ successional stages.	2012a, 2012b). In addition, a northern goshawk was detected calling 1 mile south of the Study Area during March 2012 winter tracking surveys (TRC 2012c).
Peregrine falcon	*Falco peregrinus*	USFS Sensitive; BLM Sensitive	Occupy a wide range of habitats and are typically found in open country near rivers, marshes, lakes, and coasts. Foraging habitat includes wetlands and riparian areas, meadows and parklands, croplands, gorges and mountain valleys, and lakes. Cliffs are preferred nesting sites.	Unlikely but possible. TRC did not observe any peregrine falcons within or near the Study Area during any of the baseline wildlife surveys (TRC 2012c). There is no suitable nesting habitat for peregrine falcons within the Study Area, but this species may pass through the area during migration.
Prairie falcon	*Falco mexicanus*	BLM Sensitive	Found in open situations in mountainous shrub steppe or grasslands. In Idaho, breeds in shrub steppe and dry mountainous habitat, and winters at lower elevations.	Unlikely but possible. TRC did not observe any prairie falcons within or near the Study Area during any of the baseline wildlife surveys (TRC 2012c). The Study Area contains marginal nesting habitat for this species. Prairie falcons may move through the area during migration.
Greater sage-grouse	*Centrocercus urophasianus*	BLM Sensitive; USFS Sensitive; USFS Management Indicator Species; State	See more information at beginning of this section (**Section 3.8.2)** and in the subsection (unnumbered) Greater Sage-grouse.	See more information at beginning of this section (**Section 3.8.2)** and in the subsection (unnumbered) Greater Sage-grouse.

Table 3.8-1 USFS Sensitive and Management Indicator Species for Caribou National Forest and BLM Sensitive Species for the Pocatello Field Office

Common Name	Scientific Name	Status	Preferred Habitat[1]	Potentially Occurs in Study Area?
		Protected Game Bird		
Columbian sharp-tailed grouse	*Tympanuchus phasianellus columbianus*	USFS Sensitive; USFS Management Indicator Species; BLM Sensitive	Summer and brood-rearing habitat generally consists of shrub-steppe vegetation with 20 to 40 percent shrub cover interspersed with a high diversity of forb and bunchgrasses, generally composed of 60 to 80 percent grass/forb cover. Summer habitat generally consists of grasslands or habitat edges during morning hours, moving to shrub cover during mid-day, then back to more open vegetation types toward evening. During winter, closely associated with deciduous trees and mountain shrubs in upland and riparian areas.	Yes. TRC incidentally observed a single adult sharp-tailed grouse during the 2011 wildlife surveys conducted for the project (TRC 2012b). No Columbian sharp-tailed grouse leks were observed during the 2011 aerial grouse lek surveys (TRC 2012b). Eighteen Columbian sharp-tailed grouse were observed during the February 2012 winter grouse survey. These grouse were observed in two groups. One group of five individuals was located 2 miles northwest of the Study Area, and one group of 13 individuals was located 2.3 miles northwest of the Study Area (TRC 2012c).
American three-toed woodpecker	*Picoides tridactylus*	USFS Sensitive	Found in northern coniferous and mixed forest types up to 9,000 feet in elevation. They use forests of spruce, ponderosa pine, and lodgepole pine. Nests are found in spruce, pine, and aspen trees, as well as in willow riparian, high-elevation aspen groves, in swamps, and burned-over coniferous forests.	Unlikely. TRC conducted diurnal calling surveys for the American three-toed woodpecker in May and June 2010 and June and July 2011. No three-toed woodpeckers were observed during these surveys (TRC 2012a, 2012b). Three-toed woodpeckers were also not observed during PSB surveys in the spring, summer, or fall of 2011 (TRC 2012b).
Lewis's woodpecker	*Melanerpes lewis*	BLM Sensitive	Found in open forests and woodlands (often logged or burned), including oak, coniferous forests (primarily ponderosa pine), and riparian woodlands and orchards.	Unlikely. TRC did not observe any Lewis's woodpeckers in the Study Area during PSB or any other surveys (TRC 2012b, 2012c). The preferred habitat of this species (open coniferous forests and riparian woodlands) is absent from the Study Area.
Williamson's sapsucker	*Sphyrapicus thyroideus*	BLM Sensitive	Found in montane coniferous forests, especially fir and lodgepole pine. During migration and in winter, also found in lowland forests.	Unlikely. TRC did not observe any Williamson's sapsuckers in the Study Area during PSB or any other surveys (TRC 2012b, 2012c). The preferred habitat of this species (coniferous forests) is absent from the Study Area.

Table 3.8-1 USFS Sensitive and Management Indicator Species for Caribou National Forest and BLM Sensitive Species for the Pocatello Field Office

Common Name	Scientific Name	Status	Preferred Habitat[1]	Potentially Occurs in Study Area?
Willow flycatcher	*Empidonax trailii*	BLM Sensitive	Found in thickets, scrubby and brushy areas, open second growth, swamps, and open woodlands. In an Idaho study of riparian birds, willow flycatchers were intermediate in association with mesic and xeric willow habitats.	Yes. There is suitable shrubby riparian habitat in the Study Area for this species, and willow flycatchers were observed in the Study Area during baseline PSB surveys (TRC 2012c).
Hammond's flycatcher	*Empidonax hammondii*	BLM Sensitive	Found in coniferous forests and woodlands. During migration and in winter, found in deserts and scrub, and in pine and pine/oak associations. In preliminary results of Idaho-Montana study, Hammond's flycatchers were found to be old-growth associates in Douglas-fir/ponderosa pine forests.	Unlikely. TRC did not observe any Hammond's flycatchers in the Study Area during PSB or any other surveys (TRC 2012b, 2012c). The preferred habitat of this species (coniferous forests and woodlands) is absent from the Study Area.
Olive-sided flycatcher	*Contopus borealis*	BLM Sensitive	Found in forests and woodlands (especially in burned-over areas with standing dead trees) such as taiga, subalpine coniferous forests, mixed forests, boreal bogs, muskeg, and borders of lakes and streams. Idaho study found species responded positively in numbers to single-tree logging.	Unlikely. TRC did not observe any olive-sided flycatchers in the Study Area during PSB or any other surveys (TRC 2012b, 2012c). The preferred habitat of this species (burned-over or logged coniferous forests) is absent from the Study Area.
Loggerhead shrike	*Lanius ludovicianus*	BLM Sensitive	Found in open country with scattered trees and shrubs, in savannas, desert scrub, and occasionally in open juniper woodlands. Often found on poles, wires, or fence posts.	Unlikely but possible, as there is potentially suitable habitat in the Study Area. TRC did not observe any loggerhead shrikes in the Study Area during PSB or any other surveys (TRC 2012b,c).
Sage sparrow	*Amphispiza belli*	BLM Sensitive	Found in sagebrush, saltbush brushlands, and chaparral. During migration and in winter, also found in arid plains with sparse bushes, in grasslands, and in open situations with scattered brush. One Idaho study found that nesting occurred in areas where sagebrush coverage was sparse but clumped. A recent southwestern Idaho study concluded that	Yes. Sage sparrows were observed using the sagebrush habitats in the Study Area during the baseline 2011 PSB point-count surveys (TRC 2012b).

Table 3.8-1 USFS Sensitive and Management Indicator Species for Caribou National Forest and BLM Sensitive Species for the Pocatello Field Office

Common Name	Scientific Name	Status	Preferred Habitat[1]	Potentially Occurs in Study Area?
			distribution of sage sparrows was influenced by both local vegetation cover and landscape features such as patch size.	
Brewer's sparrow	*Spizella breweri*	BLM Sensitive	Usually found in association with sagebrush. During migration and in winter, also found in desert scrub and creosote bush. Idaho study found that Brewer's sparrows prefer large, living sagebrush for nesting. A recent study in southwestern Idaho concluded that their distribution was influenced by both local vegetation cover and landscape-level features such as patch size.	Yes. Brewer's sparrows were commonly observed using the sagebrush habitats in the Study Area during the baseline 2011 PSB point-count surveys (TRC 2012b).
Virginia's warbler	*Vermivora virginiae*	BLM Sensitive	Breeds in deciduous woodlands on steep mountain slopes. Also found along mountain streams in sagebrush, or in cottonwood and willow habitat at 5,900 to 9,200 feet. Winters in arid scrub. In Idaho, species is most closely associated with pinyon/juniper woodlands and nearby riparian areas.	Unlikely. TRC did not observe any Virginia's warblers in the Study Area during PSB or any other surveys (TRC 2012b,c). The preferred habitat of this species (pinyon/juniper woodlands) is absent from the Study Area.
Trumpeter swan	*Cygnus buccinator*	USFS Sensitive; BLM Sensitive	Nesting habitat consists of marshes, lakes, beaver ponds, and oxbows and backwaters of rivers. They prefer quiet, shallow water with dense aquatic plant and invertebrate growth. Tall emergent vegetation is essential for cover. In winter, they require ice-free rivers with available aquatic vegetation.	Yes. Three trumpeter swans were incidentally observed during the February 2012 winter grouse survey. The swans were in the Upper Valley near a tributary of Diamond Creek 0.8 mile east of the Study Area (TRC 2012c). No trumpeter swans were observed during the 2011 RLB or water bird surveys conducted for the project (TRC 2012b).
Harlequin duck	*Histrionicus histrionicus*	USFS Sensitive	Usually found in streams with gradients of less than 3 degrees, greater than 50 percent streamside shrub cover, and less than three loafing sites (e.g., mid-stream boulders) every 33 feet of stream.	No. Harlequin ducks are considered unlikely to occur on the CNF. The only potential area where they may occur is McCoy Creek, which is more than 20 miles to the north of the Study Area.

Table 3.8-1 USFS Sensitive and Management Indicator Species for Caribou National Forest and BLM Sensitive Species for the Pocatello Field Office

Common Name	Scientific Name	Status	Preferred Habitat[1]	Potentially Occurs in Study Area?
American white pelican	*Pelecanus erythrorhynchos*	BLM Sensitive	Found on rivers, lakes, estuaries, and bays. In Idaho, found on large inland reservoirs and island nests.	Yes. Nine American white pelicans were observed just south of the Study Area during baseline water bird surveys conducted in June 2011 (TRC 2012b).
White-faced ibis	*Plegadis chihi*	BLM Sensitive	Found mostly in freshwater areas, marshes, swamps, ponds, and rivers. In Idaho, prefers shallow-water areas.	Yes. White-faced ibis were incidentally observed in the general vicinity of the Study Area during baseline wildlife surveys in 2011 (TRC 2012b).
Black tern	*Chlidonias niger*	BLM Sensitive	Prefers sheltered, offshore waters and bays. Found along seacoasts, bays, estuaries, lagoons, lakes, and riverschiefly during migrations or when breeding.	Unlikely but possible, as there is potentially suitable riverine habitat near the Study Area. TRC did not observe any black terns in the Study Area during RLB or any other surveys (TRC 2012b,c).
Calliope hummingbird	*Stellula calliope*	BLM Sensitive	Found in mountains (along meadows, canyons, and streams), in open montane forests, and in willow and alder thickets. During migration and in winter, found in chaparral, lowland brushy areas, and deserts.	Unlikely but possible, as there is potentially suitable habitat in the Study Area. TRC did not observe any calliope hummingbirds in the Study Area during PSB or any other surveys (TRC 2012b,c).
Columbia spotted frog	*Rana luteiventris*	USFS Sensitive	Found near permanent water such as marshy edges of ponds or lakes, algae-grown overflow pools of streams, and near springs with emergent vegetation during the breeding period. May move through mixed conifer and subalpine fir forest, grasslands, and brushlands of sage and rabbitbrush.	Unlikely. There is potentially suitable aquatic habitat within and near the Study Area; however, no Columbia spotted frogs were observed during baseline amphibian surveys conducted by GEI (GEI 2012). Furthermore, Columbia spotted frogs are not known to occur in the CNF.
Boreal toad	*Bufo boreas boreas*	USFS Sensitive; BLM Sensitive	Occupies a range of habitats including wetlands, forests, woodlands, sagebrush, meadows, and floodplains in mountains and valleys. Generally found near water, but inhabits a variety of habitat types, from sagebrush desert to mountain meadows. This species generally occurs between 7,400 and 11,800 feet in elevation (Keinath and McGee 2005).	Yes. Two boreal toads (an adult and a juvenile) were recorded at site AC-2 during August 2009 visual encounter surveys conducted by GEI (GEI 2012). Small numbers of boreal toads were also heard during spring 2011 amphibian calling surveys at every station except Stations #4 and #7 (sites AC-2 and BFR-1, respectively) (GEI 2012).

Table 3.8-1 USFS Sensitive and Management Indicator Species for Caribou National Forest and BLM Sensitive Species for the Pocatello Field Office

Common Name	Scientific Name	Status	Preferred Habitat[1]	Potentially Occurs in Study Area?
Northern leopard frog	*Rana pipiens*	BLM Sensitive	In Idaho, this species lives in marshes and wet meadows from low valleys to mountain ridges. Often associated with beaver ponds. It winters in the bottoms of ponds and lakes.	Yes. Five northern leopard frogs were collected at sites AC-2 and BFR-1 over two sampling periods in August and September 2009 during baseline visual encounter surveys (GEI 2012). A single northern leopard frog was heard at Stations #3 and #6 during spring 2011 amphibian calling surveys (GEI 2012).
Common garter snake	*Thamnophis sirtalis*	BLM Sensitive	Inhabits any type of wet or moist habitat throughout range.	Yes. One snake was observed near site BFR-1 during baseline amphibian and reptile visual encounter surveys performed by GEI in 2009. This snake escaped before it could be positively identified, but it was believed to be a common garter snake (GEI 2012).
Yellowstone cutthroat trout	*Oncorhynchus clarki bouveri*	USFS Sensitive; BLM Sensitive	Adapted to cold water. Water temperatures between 4.5 and 15.5 °C appear to be optimum for this subspecies. Spawning streams are commonly low gradient perennial streams, with groundwater- and snow-fed water sources, with gravel between 12 and 85 millimeters in diameter and water temperatures between 5.5 and 15.5°C. Large boulders and instream vegetation and woody debris are important for shade and cover (Gresswell 2011).	Yes. During baseline fish population surveys, GEI collected Yellowstone cutthroat trout from all sampled sites except for Site BFR-2 (GEI 2012). The highest density of Yellowstone cutthroat trout was observed at site AC-2. Based on the length-frequency analyses, Yellowstone cutthroat trout appear to be maintaining their populations through natural reproduction at sites LC-2 and AC-2. The size range of trout collected at sites UT-1 and AC-1-F was more limited than at the other sites, with all trout collected appearing to be juvenile fish (GEI 2012).
Northern leatherside chub	*Lepidomeda copei*	USFS Sensitive; BLM Sensitive	Prime northern leatherside chub habitat generally occurs at a lower elevation in the watershed than prime cutthroat trout habitat. Chubs have not been observed in high gradient stream reaches. They inhabit clear, cool streams and prefer a pool environment. Depends on channel complexity for cover,	Unlikely but possible. Fish sampling for this project included surveys specifically searching for northern leatherside chub. This species was historically present in Angus Creek. Northern leatherside chub have not been reported in the area in recent years, and initial sampling did not identify this species (GEI

Table 3.8-1 USFS Sensitive and Management Indicator Species for Caribou National Forest and BLM Sensitive Species for the Pocatello Field Office

Common Name	Scientific Name	Status	Preferred Habitat[1]	Potentially Occurs in Study Area?
			including large instream wood and undercut banks, particularly with overhanging vegetation. Unlikely to be found in areas with a high frequency of surface fine sediment deposition. Seldom found in eroded, heavily silted stream reaches or in areas that have been channelized.	2012). After these northern leatherside chub surveys were completed, the USFWS determined that the northern leatherside chub was not warranted protection under the ESA (76 FR 63444-63478).

Notes:
1 Information from USFS 2003 and Groves et al. 1997 except where noted.

3.8.3 Special Status Plant Species

A review of the USFWS, Idaho Fish and Wildlife Office Endangered, Threatened, Proposed, and Candidate Species List with associated proposed and critical habitats in Idaho identified no occurrences of plant species listed as Threatened, Endangered, or Proposed under the ESA in Caribou County (USFWS 2014).

Three plant species are listed as Sensitive for the CNF, and another six species are on the CNF “Forest Watch” list of rare plants. **Table 3.8-2** lists these species and each species’ potential to occur in the Study Area. BC performed a focused field survey for species with potential habitat in the Study Area. None of the species listed on the USFS Sensitive Species or Forest Watch List were recorded during 2009-2012 field surveys performed by BC (2012a,b,c).

Table 3.8-2 USFS Sensitive and Forest Watch Plant Species on the CNF

Scientific Name	Common Name	Habitat	Potential to Occur in Study Area	Documented in Study Area during 2009-2012 Field Surveys
USFS Sensitive Plant Species				
Astragalus jejunus var. *jejunus*	Starveling milkvetch	Shale of the Twin Creek Limestone Formation (Mancuso and Moseley 1990)	No, there is no suitable habitat in the Study Area.	No
Lesquerella paysonii	Payson’s bladderpod	Ridges and high peaks of the Snake River Range above the Snake River; also on Caribou Mountain (Moseley 1996)	No, there is no suitable habitat in the Study Area.	No

Table 3.8-2 USFS Sensitive and Forest Watch Plant Species on the CNF

Scientific Name	Common Name	Habitat	Potential to Occur in Study Area	Documented in Study Area during 2009-2012 Field Surveys
USFS Sensitive Plant Species				
Penstemon compactus	Cache beardtongue	High-elevation limestone substrates, on bedrock, outcrops, or cliff bands ranging from 8,800 to 9,300 feet in elevation (Moseley and Mancuso 1990)	No, there is no suitable habitat in the Study Area.	No
USFS Watch Plant Species				
Asplenium septentrionale	Grass-like spleenwort	High-elevation rocky areas	No, there is no suitable habitat in the Study Area.	No
Asplenium tricomanes-ramosum	Green spleenwort	Moist limestone or other basic substrates at high elevations (Moseley and Mancuso 1990)	No, there is no suitable habitat in the Study Area.	No
Carex idahoa	Idaho sedge	Low, level wetland transition zones within the Blackfoot River watershed	The IDFG recorded Idaho sedge within the southern boundary of the Study Area in 2010 (**Figure 3.5-1**).	The August 2011 survey did not locate the occurrences noted by the IDFG, nor did it find any new occurrences of Idaho sedge in the Study Area (BC 2012a).
Ericameria discoidea var. *winwardii*	Winward's goldenbush	Only on barren Twin Creek Limestone outcrops on the Montpelier Ranger District	No, there is no suitable habitat in the Study Area.	No
Musineon lineare	Rydberg's musineon	Ledges and crevices on near-vertical outcrops between 8,200 and 9,000 feet in elevation (Moseley and Mancuso 1990; Mancuso 2003)	No, there is no suitable habitat in the Study Area.	No
Salicornia rubra	Red glasswort	Low-elevation flats; prefers basic, saline soils	Yes	No

Source: BC 2012a

Sixteen species of plants that the BLM lists as Sensitive or Species of Concern are known to occur within the area managed by the PFO. These species, along with a preliminary assessment regarding their potential occurrence within the Study Area, are listed in **Table 3.8-3**. A field survey was performed for the four species identified as having potential habitat in the Study Area (**Table**

3.8-3). None of these species were recorded during 2009-2012 field surveys performed by BC (2012a,b,c).

Table 3.8-3 BLM Pocatello Office Sensitive Plant Species and Species of Concern

Scientific Name	Common Name	Habitat	Potential to Occur in Study Area	Documented in Study Area during Field Surveys
Type 2 Plant Species (Rangewide/Globally Imperiled Species – High Endangerment)				
Astragalus jejunus var. *jejunus*	Starveling milkvetch	Shale of the Twin Creek Limestone Formation (Mancuso and Moseley 1990)	No, there is no suitable habitat in the Study Area.	No
Eriogonum hookeri	Hooker's buckwheat	Sandy washes, flats, and slopes in saltbush, greasewood, sagebrush, and mountain mahogany communities at 4,200 to 8,200 feet in elevation (SEINet 2011)	No, this species is not known to occur in Caribou County.	No
Type 3 Plant Species (Rangewide/Globally Imperiled Species – Moderate Endangerment)				
Aspicilia fruticulosa	Coral lichen	Calcareous soil in black sagebrush or badland communities (Hagwood 2006)	No, there is no suitable habitat in the Study Area.	No
Cryptantha breviflora	Uinta Basin cryptantha	Shale of the Twin Creek Limestone Formation (Mancuso and Moseley 1990)	No, there is no suitable habitat in the Study Area.	No
Ericameria discoidea var. *winwardii*	Winward's goldenbush	White clay-shale slopes and outwash (Kinter 2009)	No, there is no suitable habitat in the Study Area.	No
Eriogonum desertorum	Great Basin desert buckwheat	Silty or gravelly to clayey flats, slopes, and ridges, often on limestone soils, in mixed grassland, saltbush, and sagebrush communities from 4,900 to 9,800 feet in elevation (eFloras.org 2005)	No, this species is not known to occur in Caribou County.	No
Type 4 Plant Species (Species of Concern)				
Carex tumulicola	Foothill sedge	Dry slopes and meadows (Moseley 1992)	No, this species is not known to occur in Caribou County.	No

Table 3.8-3 BLM Pocatello Office Sensitive Plant Species and Species of Concern

Scientific Name	Common Name	Habitat	Potential to Occur in Study Area	Documented in Study Area during Field Surveys
Cercocarpus montanus	Birchleaf mountain-mahogany	Sagebrush, mountain shrublands, and pinyon-juniper woodlands; also openings of ponderosa pine, mixed conifer, and aspen forests (Kitchen date unknown)	No, this species is not known to occur in Caribou County.	No
Cryptantha caespitosa	Tufted cryptantha	Exposed ridgelines with shallow, shaly soils in low sagebrush (*Artemisia arbuscula*) or black sagebrush (*Artemisia nova*) communities (Moseley 1991)	Yes	No
Cryptantha sericea	Silky cryptantha	Heavy clay soils, 4,200 to 7,000 feet in elevation (Higgins 1971)	No, this species is not known to occur in Caribou County.	No
Cymopterus ibapensis	Ibapah spring parsley	No information available	No, this species is not known to occur in Caribou County.	No
Hymenoxys cooperi var. *canescens*	Cooper's rubber-plant	No information available	No, this species is not known to occur in Caribou County.	No
Muhlenbergia racemosa	Green muhly	Dry to moist sites, streambanks, lake margins, irrigation ditches, and dry slopes from 4,100 to 10,400 feet in elevation (Zouhar 2011)	Yes	No
Nassella viridula	Green needlegrass	Plains, prairies, foothills, mountain meadows, open woodlands, and hillsides (Mancuso and Moseley 1992)	Yes	No
Salicornia rubra	Red glasswort	Low-elevation flats; prefers basic, saline soils	Yes	No
Salix candida	Hoary willow	Bogs, fens, marshes, pond edges, and seepage areas (IDFG 2011)	Yes	No

Source: BC 2012a

3.9 VISUAL RESOURCES

Visual resources are a composite of terrain, geologic features, water features, vegetative patterns, structures, and land use activities that typify an area. The intrinsic beauty of the Study Area is valued by visitors and residents. The character of the landscape, potential viewing locations, and number of viewers are important factors to consider when describing the visual resources of an area.

Visual resources are important to the expectations and experiences of visitors and residents. Scenic landscapes contribute to the quality of life for local communities and can provide economic benefits to communities when they provide high-quality scenic settings for outdoor recreational experiences.

The analysis area for visual resources is the Study Area and the surrounding areas and vantage points from which the public may view portions of the Study Area. The analysis area for visual resources is shown on **Figure 3.9-1**.

3.9.1 Visual Resource Management Agencies

Portions of the Study Area are located on the CTNF lands managed by the USFS, BLM lands managed by the PFO, land within the Blackfoot River WMA managed by the IDFG, and private lands. The affected environment description for visual and aesthetic resources distinguishes among the USFS lands, BLM lands, and non-federal lands. Land management objectives for USFS and BLM lands are summarized in the following subsections.

3.9.1.1 USFS Visual Management System

The CTNF lands in the Study Area have been classified by Visual Quality Objectives (VQOs) in the USFS' Visual Management System (VMS). VQOs are assigned using guidelines established for scenic quality, visual sensitivity, and visibility. The main objective is maintaining and enhancing the natural appearance of the characteristic landscape while actively managing for various benefits. These benefits can include timber production, livestock grazing, wildlife habitat, mineral extraction, and dispersed recreation.

The VMS has five VQOs, each of which represents a different degree of acceptable alteration of the natural-appearing landscape. From most restrictive to least restrictive, the VQOs are:

- Preservation (P) - Ecological change only.
- Retention (R) - Human activities should not be evident to the casual Forest visitor.
- Partial Retention (PR) - Human activities may be evident but must remain subordinate to the characteristic landscape.
- Modification (M) - Human activity may dominate the characteristic landscape, but at the same time must adopt naturally occurring elements of the landscape including form, line, color, and texture.
- Maximum Modification (MM) - Human activity may dominate the characteristic landscape, but should appear as a natural occurrence when viewed as a background.

The CTNF lands within the Study Area and the area that encompasses the South and Central Rasmussen Ridge Mines are classified as Modification (**Figure 3.9-2**). Accordingly, management activities may dominate the original characteristic landscape. No scenic trails or scenic byways have been designated within the Study Area.

3.9.1.2 BLM Visual Resource Management

The BLM's Visual Resource Management (VRM) system is used to identify and protect scenic lands, especially those viewed most by the public. The BLM uses the VRM system to inventory, classify, and manage visual resources. In part, VRM classes define the amount of disturbance an area can tolerate before it no longer meets the visual quality of that class. The four VRM classes and objectives for acceptable levels of change are:

- Class I Objective: To preserve the existing character of the landscape. The level of change to the characteristic landscape should be low and must not attract attention.
- Class II Objective: To retain the existing character of the landscape. The level of change to the characteristic landscape should be low.
- Class III Objective: To partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate.
- Class IV Objective: To provide for management activities which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high.

Although most of the Study Area is not BLM-administered land, there is some BLM-administered land within Section 9 in the southeastern portion of the Study Area. The BLM-administered lands in the southeastern portion of the Study Area are located within areas designated as VRM Class III (**Figure 3.9-2**).

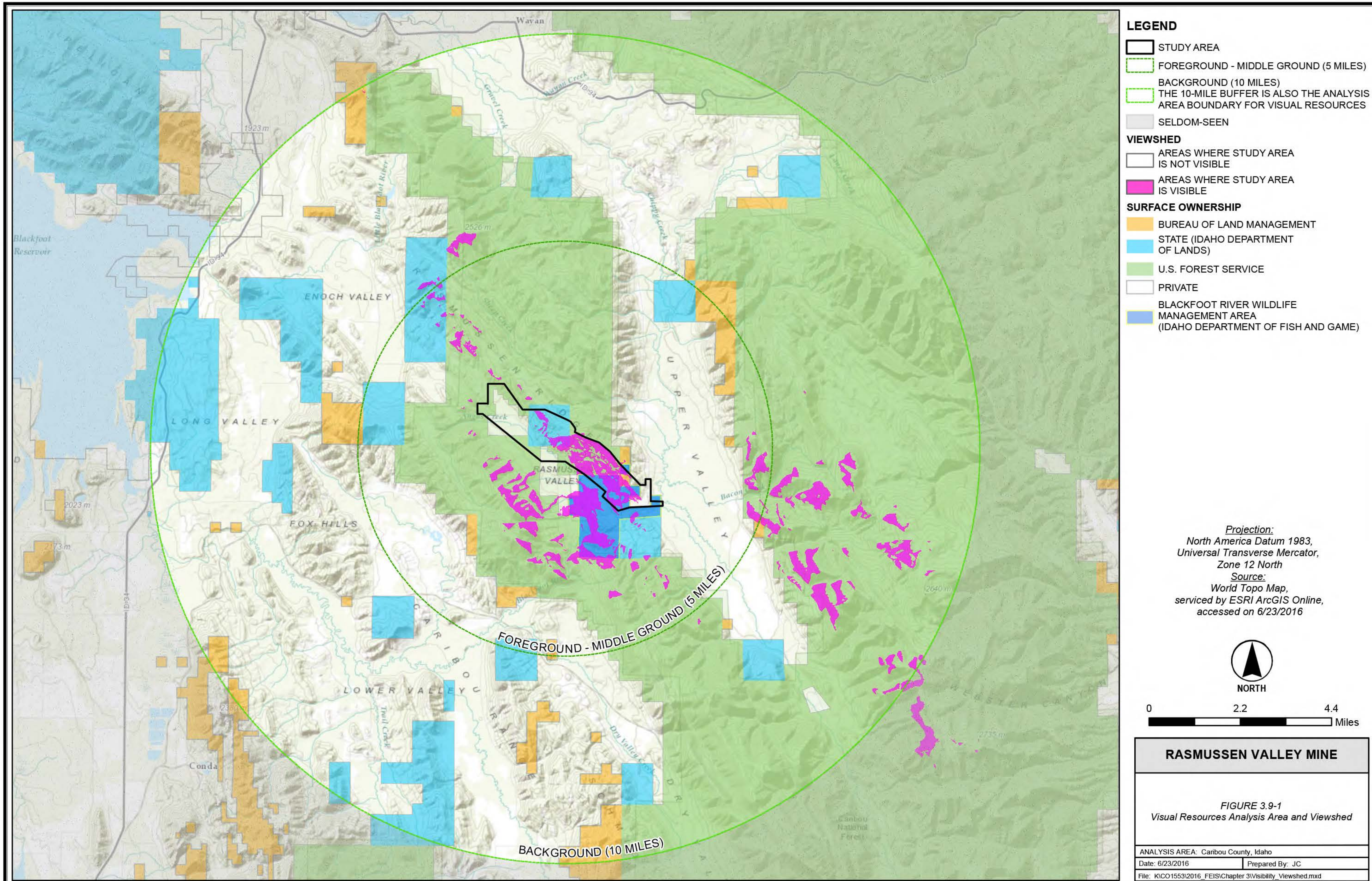
Landscapes are subdivided into three distance zones based on relative visibility from travel routes or observation points. The zones are foreground-middleground, background, and seldom-seen. The foreground-middleground zone includes areas seen from highways, rivers, or other viewing locations that are less than 3 to 5 miles away. Areas beyond the foreground-middleground zone, but usually less than 15 miles away, are in the background zone. Areas not seen as foreground-middleground or background are in the seldom-seen zone because they are typically hidden from view.

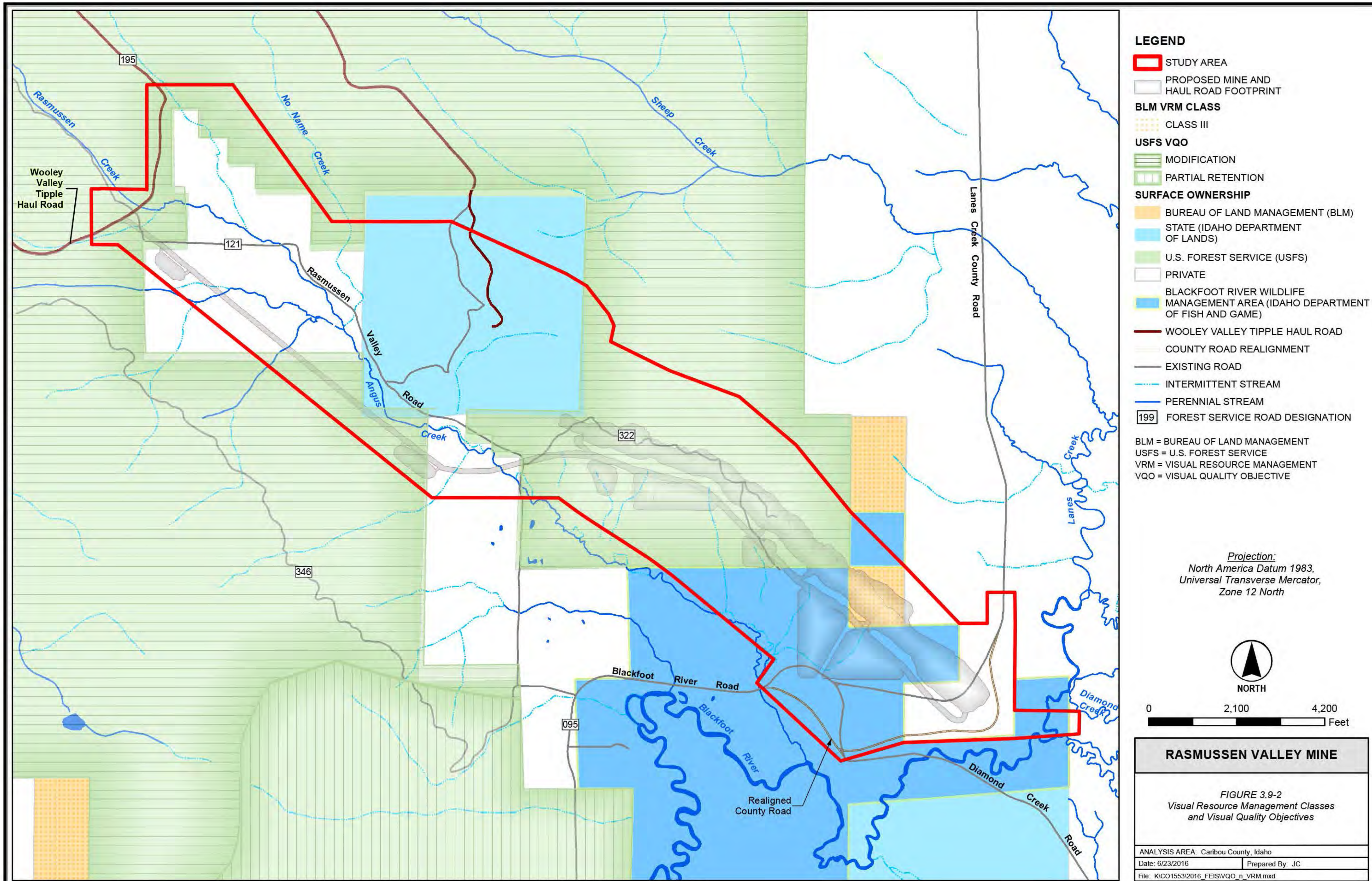
3.9.2 Existing Landscape Character

Landscape character creates a "sense of place" and describes the overall impression created by natural biophysical attributes, natural processes, and human influences on a geographic area. Natural attributes include geology, soils, landforms, vegetation, and water features. No designated scenic trails, highways, or byways exist in or near the Study Area. The existing landscape character of the Study Area, described in the following paragraphs, is typical of the region.

The existing landscape character of the Study Area is characterized by a combination of rolling plains, foothills, and rugged ridges typical of the region. The Study Area is characterized by a series of north- to northwest-trending mountain ranges separated by broad valleys. The northeastern portion of the Study Area rises to the crest of Rasmussen Ridge, characterized by moderate to steep slopes.

The Blackfoot River bends around the southeast end of the Study Area. Lanes Creek is located east of the Study Area. The southwestern portion of the Study Area in the Rasmussen Valley includes Angus Creek.


LEGEND
STUDY AREA
FOREGROUND - MIDDLE GROUND (5 MILES)
BACKGROUND (10 MILES)
THE 10-MILE BUFFER IS ALSO THE ANALYSIS AREA BOUNDARY FOR VISUAL RESOURCES
SELDOM-SEEN
VIEWSHED
AREAS WHERE STUDY AREA IS NOT VISIBLE
AREAS WHERE STUDY AREA IS VISIBLE
SURFACE OWNERSHIP
BUREAU OF LAND MANAGEMENT
STATE (IDAHO DEPARTMENT OF LANDS)
U.S. FOREST SERVICE
PRIVATE
BLACKFOOT RIVER WILDLIFE MANAGEMENT AREA
(IDAHO DEPARTMENT OF FISH AND GAME)
Projection:
North America Datum 1983,
Universal Transverse Mercator,
Zone 12 North
Source:
World Topo Map,
serviced by ESRI ArcGIS Online,
accessed on 6/23/2016
NORTH
0
2.2
4.4
Miles
RASMUSSEN VALLEY MINE
FIGURE 3.9-1
Visual Resources Analysis Area and Viewshed
ANALYSIS AREA: Caribou County, Idaho
Date: 6/23/2016
Prepared By: JC
File: K:\CO1553\2016_FEIS\Chapter 3\Visibility_Viewshed.mxd
FOREGROUND - MIDDLE GROUND (5 MILES)
BACKGROUND (10 MILES)
Wayan
Blackfoot Reservoir
ENOCH VALLEY
LONG VALLEY
FOX HILLS
LOWER VALLEY
UPPER VALLEY
CARIBOU RANGE
RASMUSSEN VALLEY
Conda
1923 m
2526 m
2023 m
2640 m
2735 m



RASMUSSEN VALLEY MINE

FIGURE 3.9-2
Visual Resource Management Classes and Visual Quality Objectives

ANALYSIS AREA: Caribou County, Idaho
Date: 6/23/2016 Prepared By: JC
File: K:\CO1553\2016_FEIS\VQO_n_VRM.mxd

There is a broad band of aspen woodland on the upper slopes of Rasmussen Ridge. The aspen woodland includes four strata as described in **Section 3.5.1.1.** Big sagebrush rangeland occupies the high plains and the arid lower mountain slopes. Grasses and forbs grow in moderate to sparse quantities between sagebrush on arid rangeland. High-sagebrush rangeland occupies the high plains and the arid lower mountain slopes. Grasses and forbs grow in moderate to sparse quantities between sagebrush on arid rangeland. High-elevation rangeland is a vegetation cover type that occurs at higher elevations than big sagebrush rangeland, typically above 6,600 feet in elevation. Many of the same plant species are present in the high-elevation rangeland cover type, but increased moisture at higher elevations also favors a greater diversity of shrubs and some trees. Silver sagebrush rangeland occupies an elevation zone between mesic emergent/ponded wetland and big sagebrush rangeland near the valley bottom. The Angus Creek stream channel and extended floodplain are dominated by a mix of forbs and sedge/grass wetland meadows and silver sagebrush rangeland. Relatively narrow willow corridors occur along Angus Creek and tributaries; however, in some areas, intensive grazing by cattle has removed all woody vegetation. Study Area vegetation is described in detail in **Section 3.5**.

Mining and mineral exploration have modified the landscape character of the analysis area. Phosphate mining and exploration have occurred in the region since 1912. Modifications to the landscape character of the analysis area include the Enoch Valley Mine, located on the western flank of Rasmussen Ridge at the north end of the Rasmussen Valley, 0.33 mile west of the Rasmussen Ridge Mines. Additional modifications to the landscape character of the analysis area include the construction of P4's South Rasmussen Mine (largely within the north-central portion of the Study Area), a haul road to service the Rasmussen Ridge Mines and South Rasmussen Mine immediately north of the Study Area, and stripping of topsoil at P4’s South Rasmussen Mine.

In addition to mining and exploration activities, existing visual modifications to the landscape in and near the analysis area have resulted from livestock grazing, housing developments, timber harvests, and vegetation treatments which have modified the natural landscape. Man-made features currently visible in the Study Area include mining and exploration facilities, livestock corrals and fences, stock watering ponds, roads, trails, signs, utilities, buildings, homesteads, and developed recreational facilities.

Low-light condition, or dark skies, is one of the most important properties for viewing stars, constellations, and other astronomical features. The analysis area is relatively remote and rural, with few existing light sources. Existing sources of artificial nighttime light within the Study Area include the lights from vehicles traveling on Blackfoot River Road (FR 095), Rasmussen Valley Road (FR 121), and Diamond Creek Road (FR 102). In addition, lights from mining equipment and rural residences are visible from publicly accessible roads in and near the Study Area.

3.9.3 Visual Sensitivity

“Visual sensitivity” is a measure of public concern for scenic quality and existing or proposed visual change. Areas that are visible from many locations or at close range are more sensitive to modifications of the characteristic landscape. Aesthetic value and visual appeal are inherently subjective. Viewing distance and screening by vegetation or topography are aspects considered in evaluating the sensitivity of the landscape. Factors typically considered when measuring public concern include type of users, degree of public access and use of an area (number of viewers), public interest, and adjacent land uses.

The analysis area is sparsely populated; therefore, the Study Area is visible to a few casual observers traveling on Blackfoot River Road, Rasmussen Valley Road, Diamond Creek Road, and Lanes Creek Road. Based on the results of the viewshed analysis (as discussed in the introduction to **Section 3.9**), the areas within the Study Area that are potentially visible from public roads are shown in purple on **Figure 3.9-1**. Views of the Study Area are limited by mountain ranges, rugged terrain, and forested areas.

Seasonal residents, such as those who reside seasonally along Lanes Creek and Rasmussen Valley Roads in particular, value the visual beauty of the area. The backdrop for these ranches and summer homes is one of brush-covered hills and steep, forested slopes; therefore, the area retains its rural, agricultural setting. Several homes and outbuildings, as well as fences, gates, a power line, and pasturelands, are evident along the road.

In general, users of the Study Area are accustomed to viewing mineral resource development; however, visual quality is an important part of the recreational experience for many users. Recreationists who hike, fish, or camp regularly in this portion of the CTNF or the Blackfoot River WMA are likely to value the scenic quality of the surrounding landscapes. Public use of the Study Area is highest during elk and deer hunting seasons. Hunters would also value the scenic landscape as a part of their recreational experience; however, a successful hunt would not necessarily depend on the scenic quality of the surrounding landscapes.

3.10 LAND USE, ACCESS, AND TRANSPORTATION

The analysis area includes the footprint of the Proposed Action and adjacent land accessible by roads that may be used to access the Proposed Action as described in **Chapter 1** (**Figure 1.2–2**).

3.10.1 Land Status/Ownership

Surface ownership in the region is a mix of federal, state, tribal, and private lands. The Proposed Action is primarily located within the Caribou portion of the CTNF on land administered by the Soda Springs Ranger District. Portions also involve federal lands administered by the BLM, state lands administered by the IDFG, state lands administered by the IDL, and private lands. The mine pit and Lease are located within the known phosphate leasing area (KPLA) boundaries. Support features, such as haul roads, extend off the KPLA area onto federal and private lands.

3.10.2 Land Use Regulations/Management

The project must comply with the land use regulations, policies, plans, and programs of the various land management agencies. As described in **Section 1.5**, the CNF RFP (USFS 2003) and the PFO ARMP (BLM 2012a) guide land use development on federal lands in the Land Use Study Area. Note that seasonal activity restrictions to protect wildlife contained in the ARMP generally do not apply to mining activities. (Action PP-ME-2.5.5 -Seasonal restrictions would not apply to the operation and maintenance of solid leasable mineral production facilities unless the findings of analysis demonstrate the continued need for such mitigation and that less stringent, project-specific mitigation measures would be insufficient.)

3.10.3 Existing Land Uses

Existing land uses within the analysis area include commercial mining, timber management, domestic livestock grazing, and recreation. The current and historical land use for federal and state lands within the analysis area is primarily rangeland used for livestock grazing except the WMA, which does not allow livestock grazing. The state section in north-central portion of the

Study Area is dominated by the South Rasmussen Mine, which has ceased production and is undergoing reclamation.

3.10.3.1 Commercial Mining

Exploration for and mining of phosphate, which has occurred since the early 1900s, has disturbed land within the analysis area. Since 2008, Agrium has been systematically exploring Federal Phosphate Lease I-05975 and the federal phosphate split estate on Agrium property immediately south of the Lease. Exploratory activities have disturbed 28 acres of the analysis area (**Section 2.2**).

Agrium has several phosphate operations nearby. Agrium's CPO fertilizer manufacturing plant is located at Conda, 12 miles southwest of the analysis area. The plant produces phosphate fertilizers from phosphate ore currently obtained from Agrium's North Rasmussen Ridge Mine, located north of the analysis area. The Proposed Action would use the Wooley Valley Tipple Haul Road, which is currently used to haul phosphate ore from the North Rasmussen Ridge Mine and for access to existing shop and maintenance facilities that currently support the North Rasmussen Ridge Mine.

Other active, abandoned, idled, or reclaimed phosphate mines also exist in the region including the 490-acre South Rasmussen Mine, which extends into the northern portion of the Study Area, and the 42-acre Lanes Creek Mine, which is on private land east of the Study Area.

3.10.3.2 Timber Management

The analysis area is not used for the harvest of timber. The CNF RFP states that lands within the analysis area are "removed from the suitable timber base"; in addition, lands within the analysis area are labeled as "National Forest Land that is not Tentatively Suitable Timber". No commercial timber harvest is known to occur on the Blackfoot River WMA, and no timber sales have occurred on other state lands within the Study Area since at least 2010.

3.10.3.3 Livestock Grazing

Livestock grazing has been a historical and traditional use of lands in the region surrounding the Study Area. Sheep were brought into the area as early as the 1830s by missionaries and emigrants, and small herds of cattle were driven into the region during the 1860s.

The Taylor Grazing Act of 1934 created grazing districts throughout the west. Grazing districts are further divided into grazing allotments to provide for the orderly administration and proper grazing use of public lands. The Study Area is located within Angus Creek Unit 3A in the northern portion of the CTNF Rasmussen Valley Cattle Allotment (RVCA). This USFS grazing allotment does not include adjacent BLM, state, or private lands. The BLM lands in Section 9 do not include a grazing allotment. The Blackfoot River WMA can allow livestock grazing, but does not currently support any. There are no grazing leases on other adjacent state lands.

Under the terms of the Annual Operating Instructions (AOIs) for the 2013 grazing season, the RVCA lessee was limited to 378 cattle (cows and calves) from June 11 to September 30 (USFS 2013). The AOIs include stipulations concerning grazing in riparian areas, the potential for selenium uptake, restricted grazing on wildlife winter range, control of noxious weeds (including use of certified weed-free hay), limited off-road travel, fence maintenance standards, and water control. The number of animals approved for the allotment has remained the same since at least 2011.

3.10.3.4 Recreation

Public lands administered by the CTNF and BLM provide a wide variety of opportunities for year-round recreation. Recreational opportunities include camping, hiking, fishing, hunting, snowmobiling, horseback riding, and mountain biking.

Recreation sites and activities are divided into two broad categories: developed and dispersed. Developed recreation sites are areas of concentrated development, such as a campground or trailhead with improvements. No developed campgrounds exist within the analysis area. The closest developed campground is the Mill Canyon National Forest Campground 2 miles west of the Study Area.

Dispersed recreation requires few, if any, improvements and occurs typically in conjunction with roads or trails. Dispersed activities are often day-use oriented and involve many types of activities. Examples of dispersed recreation include fishing, hunting, berry picking, off-road vehicle use, hiking, horseback riding, picnicking, camping, viewing and photographing scenery, and snowmobiling. Hunting, fishing, and other outdoor activities account for most recreational uses in Caribou County.

Existing roadways provide access for recreational uses within the analysis area. These roadways include FR 322, a trail that branches east from Rasmussen Valley Road (**Figure 1.2-2**). This trail is open only to vehicles less than 50 inches wide.

The CTNF uses a planning tool, the Recreation Opportunity Spectrum (ROS) to inventory and manage recreational areas and activities. The ROS categorizes recreational settings by the amount of development and other attributes. ROS classes help visitors find the setting that best provides for their desired experience. Two ROS categories occur in the analysis area: Semi-Primitive Motorized (SPM) and Roaded Modified (RM).

The setting for SPM lands includes a moderate probability of solitude, closeness to nature, a high degree of challenge and risk using motorized equipment, a predominantly natural-appearing environment, few users (but evidence shows on trails), and few vegetation alterations that are widely dispersed and visually subordinate. SPM areas range in size from 2,500 to 5,000 acres that are screened by vegetation or topography, creating a “buffer” from surrounding development. The USFS lands east of the state section that includes the Lease and adjacent areas are designated as SPM.

The setting for RM lands includes the opportunity to be with others in developed sites, little challenge or risk, relatively natural-appearing environment as viewed from roads and trails, moderate evidence of human activity, and access and travel by standardized motor vehicles. Although resource modification and utilization are evident, they generally harmonize with the natural environment. RM areas in the project generally follow Blackfoot River Road.

Hunting is a major recreational use, as well as a tribal treaty right use of the analysis area. The IDFG manages hunting and game populations in game management units or hunt units. Hunting seasons for big game occur from late August through mid-December. Seasons include archery, any weapon, and controlled hunts. Major species of big game are mule deer and elk. Although they occur in the area, white-tailed deer and pronghorn are scarce. Limited hunting of black bear and mountain lion also occurs.

The Proposed Action is in the northern part of Game Management Unit 76 and in the larger Diamond Creek Elk Zone. The Blackfoot River WMA is also at the south end of the analysis area.

Hunters enter the area near the proposed mine from Rasmussen Valley Road, Blackfoot River Road where it runs along the edge of the WMA, Lanes Creek Road, the CTNF, or across private land with permission of the landowner.

Although fishing is popular along portions of Angus Creek, most fishing occurs farther down on the Blackfoot River and at the Blackfoot Reservoir. No quantitative data exist on use of the analysis area by anglers or hunters. The IDFG has collected some data for the Blackfoot River WMA, which includes part of the analysis area. This WMA has experienced 400 to 500 angler days, 50 to 75 big game hunter days, 30 to 40 waterfowl hunter days, and 25 to 30 upland game hunter days (IDFG 1999). In addition, it is used for "outdoor appreciation and trapping."

The Shoshone and Bannock Tribes (Tribes) have reserved treaty rights that they exercise to hunt and fish on unoccupied public lands in the general area. The Tribes establish the hunting and fishing seasons to be followed by their members.

3.10.3.5 Off-highway Vehicle and/or All-terrain Vehicle Use

Off-highway vehicles (OHVs) are defined as any vehicle designed to travel off paved roadways. They include full-sized four-wheel-drive vehicles, motorcycles, all-terrain vehicles (ATVs), and snowmobiles. OHV use on public lands has been a concern since the 1970s. This concern was reflected in EOs 11644 and 11989, which established policies and procedures to control and direct the use of OHVs on federal lands and directed agency heads to close areas or trails if OHVs were causing considerable adverse effects. USFS motorized ATV trails 322 and 322B currently are located on the Proposed Action.

In 2005, the USFS issued a travel management regulation, in part to standardize the process that individual national forests and grasslands use to designate the roads, trails, and areas that will be open to motorized travel. In response, the CTNF implemented its Revised Caribou Travel Plan. This plan identifies the opportunities for and restrictions on public travel on lands in the analysis area during both winter and summer.

The EIS prepared during the development of the Revised Caribou Travel Plan notes that use of ATVs on the CTNF grew in the early 2000s, and that ATV use in remote areas increased from 1995 through 2005 (USFS 2005). This increased use is a reflection of the 350-percent increase in the number of OHVs registered in the State of Idaho over the same period (State of Idaho 2011). The CTNF estimates that, during that time, 11 percent of its visitors participated in snowmobiling, and 5 percent engaged in motorized trail activity and OHV use. Nine percent of visitors indicated that snowmobiling was the main activity they pursued during a visit, making it the fourth most popular main activity on the CTNF (USFS 2014c). No public OHV use is permitted on the Blackfoot River WMA (IDFG 2014).

3.10.3.6 Special Designation Lands

Specially designated federal lands include Inventoried Roadless Areas, Wilderness Areas, Recommended Wilderness Areas, Research Natural Areas, and Wild and Scenic Rivers. No lands with these designations occur in or near the analysis area. The Blackfoot River WMA is the only specially designated state land in or near the analysis area.

3.10.4 Transportation and Access

The analysis area can be accessed by State Highway 34, county roads, and forest roads (FRs). State Highway 34 is a two-lane, paved arterial roadway connecting Soda Springs at U.S. Highway

30 with recreation areas at Blackfoot Reservoir and with western Wyoming. Blackfoot River Road (FR 095) and Lanes Creek Road are paved two-lane roads. Rasmussen Valley Road (FR 121) is an unpaved road that links the project to Long Valley Road and Blackfoot River Road, and thus to State Highway 34. These roads near the Proposed Action provide access to existing phosphate mining operations, ranches, dispersed rural residences, and dispersed recreation in the CTNF and surrounding areas.

Annual average daily traffic (AADT) is defined as the total volume of vehicle traffic on a road for 1 year, divided by 365 days. **Table 3.10-1** provides the AADT for State Highways 30 and 34 at several locations near the analysis area and along potential commuting routes from surrounding communities. Traffic count stations have not been installed on the roads that provide direct access to the Proposed Action. There is no public transportation in the analysis area.

Table 3.10-1 Annual Average Daily Traffic

Location	AADT, 1990	AADT, 2000	AADT, 2010	AADT, 2012
Highway 30, East of Soda Springs	5,140	6,400	5,700	5,600
Highway 34, Between Soda Springs and Conda	2,690	2,600	2,800	2,400
Highway 34, Between Conda and Henry	770	1,000	610	610
Highway 30 at Georgetown	2,230	3,800	2,800	2,700
Highway, 30 at Montpelier	3,560	4,800	3,900	3,700

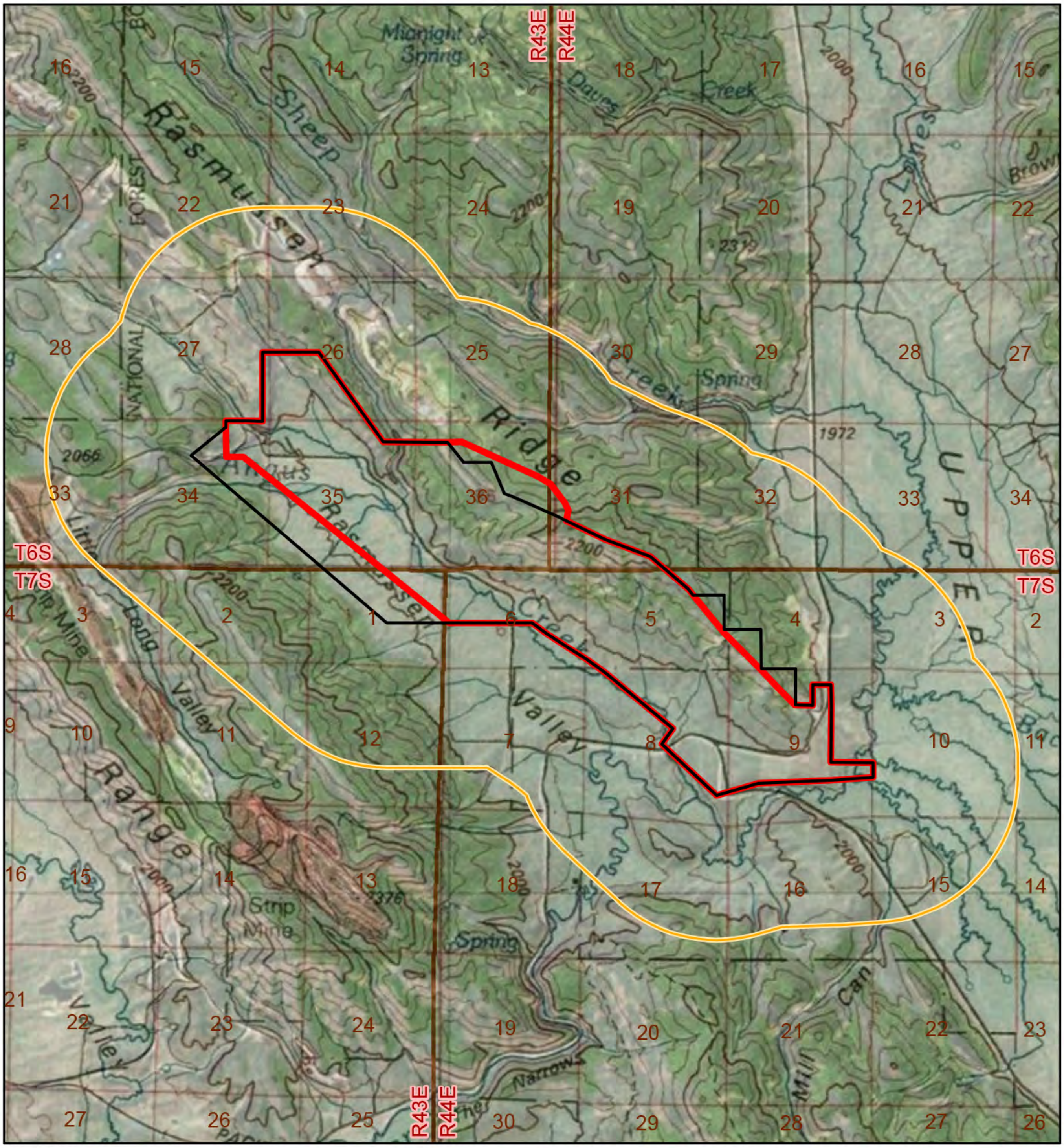
Source: Idaho Department of Transportation (IDOT) 1990, 2000, 2010, 2012

3.11 CULTURAL RESOURCES

The analysis for cultural resources anticipated several potential alternative elements that were not carried through for detailed analysis. Consequently, there is a cultural resources Survey Area that is different from and slightly larger than the Study Area defined in **Chapter 2**. In addition, the cultural resources analysis area for which a records search and background documentary review was completed was the Survey Area and a 1-mile buffer in all directions (**Figure 3.11-1**). Several previous baseline cultural resource surveys had been completed in the Survey Area for this Proposed Action, and an additional baseline survey was completed (Späth 2012) to fill in gaps in survey coverage and to resolve outstanding issues.

Cultural resources are the material remains of past human activities and locations or landmarks associated with important historical or traditional events. They may include buildings, structures, landscape modifications, traditional locations or landmarks, cultural features, or portable artifacts (objects of human manufacture). Cultural sites (locations of past human activity) consisting of surface or buried features and artifacts without buildings or standing structures are referred to as archaeological sites. Cultural resources can be prehistoric, historic, or both, meaning that the remains may date from before or after the beginning of European settlement in the region.

Cultural resources can include resources, landscape features, or traditional locations that are important to the heritage and identity of existing cultural groups, such as traditional cultural properties (TCPs). In most cases, TCPs are also Native American religious or traditional values. Evaluation and management of TCPs, tribal historic and archaeological sites, or traditional locations and landscapes ideally involves agency coordination with the Tribes, integration with tribal treaty rights and interests, and the opportunity for the Tribes to participate in the identification and interpretation of cultural resources.



LEGEND

STUDY AREA
CULTURAL RESOURCES SURVEY AREA
CULTURAL RESOURCES ANALYSIS AREA

Projection:
North America Datum 1983,
Universal Transverse Mercator,
Zone 12 North
Source:
World Imagery Map (with 50% transparency) and USA Topo Map; both serviced by ESRI ArcGIS Online, accessed on 8/30/2016

NORTH

0 2,750 5,500 Feet

RASMUSSEN VALLEY MINE

FIGURE 3.11-1
Cultural Resources Survey Area and Analysis Area in Comparison to the Study Area

ANALYSIS AREA: Caribou County, Idaho
Date: 8/30/2016 | Prepared By: JC
File: K:\CO1553\2016_FEIS\Chapter3\Cultural.mxd

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3.11.1 Prehistoric Context

Southeastern Idaho is in the Snake and Salmon River culture area of the northern Great Basin (Butler 1986). The analysis area is in the Central Rocky Mountains at the eastern edge of this area, and comparative materials of the Mountain Tradition must be considered. The prehistory of the region is typically divided into three broad periods: (1) Paleoindian (12,000 to 7,800 years ago); (2) Archaic (7,800 to 300 years ago); and (3) Protohistoric (from about 300 years ago to European settlement of the area in the 1840s). Each of these periods is characterized by distinct artifact types and by different settlement and subsistence patterns. Because there were no prehistoric sites in the Survey Area that could be identified to a specific period, the defining characteristics of these periods are not discussed here. More detail is available in the initial baseline cultural resources inventory report (Ferriman 2011).

3.11.2 Historic Context

The earliest documented accounts of Euroamericans in southeastern Idaho are of fur trappers and explorers in the early 1800s. By the 1840s, emigrants to the West Coast were following the trails identified by the earlier explorers and fur trappers. The Hudspeth Cutoff of the Oregon and California Trail passed through Soda Springs 18 miles southwest of the Study Area. The improved Lander Road branch of the Oregon and California Trail crossed the Caribou Range from the Star Valley in western Wyoming and descended to Lanes Creek 7 miles north-northeast of the Survey Area. From there, the Lander Road passed between Grays Lake and Grays Range and continued west to Fort Hall, rejoining the main route of the Oregon and California Trail. The Lander Road diverged from the more heavily travelled variants of the trail in Wyoming east of South Pass bypassing the popular waypoint of Fort Bridger, and was a shorter route from the Sweetwater Valley in Wyoming to Fort Hall in Idaho. Thus, the Survey Area is located between two major east-west branches of the Oregon and California Trail, and lesser trails may have connected these branches where the terrain was favorable.

In the 1860s, Mormon pioneers established settlements in southeastern Idaho. The discovery of gold in the Idaho panhandle in 1861 brought an influx of miners to the region. Subsequent discovery of gold near the Caribou Mountains drew some of that activity to the Caribou Mountains. The regional mining boom continued into the 1890s. From 1870 to 1920, Soda Springs was a major supply point for mining camps in the Caribou Mountain area. With the building of the transcontinental railroad in the 1860s, railroad workers also entered the region. Tie hack camps supplied ties for the transcontinental railroad, and the timber industry supplied the mines and the growing towns. Even though the timber resources of southeastern Idaho are not as abundant as in other parts of the state, they played a key role in the development of the region. Cattlemen entered the region in the 1860s to supply the mines and eastern markets. Precious metal mining around Soda Springs was followed by phosphate exploration and mining, which continues to this day.

Although sheep had been brought into the region along the emigrant trails, large herds were not established in Caribou County until the 1890s. The mining opportunities and railroad construction also attracted Chinese emigrants, and later, Japanese. Some homesteading took place in southeastern Idaho in the 1890s and early 1900s, but many of those homesteads failed in the 1920s and 1930s and reverted to federal control. Much of Idaho is public land including extensive National Forests. The CNF, established in 1907, covers most of the Caribou Mountains and Webster Ridges in eastern Caribou County. These forests are part of the Greater Yellowstone Ecosystem. Most of the readily visible historic resources around the upper Blackfoot River in eastern Caribou County are dominated by farming, ranching, mining, scattered timber harvesting, and recreation associated with the Blackfoot River, Blackfoot Reservoir, and the CNF.

3.11.3 Previous Studies and Known Resources

A baseline cultural resources inventory of the Study Area as defined in 2010 was completed in the fall of 2010 (Ferriman 2011). Cultural resources inventories had been completed for Agrium the previous year for exploratory drilling in the valley bottom (Mason 2009) and for the phosphate lease area (Harding 2009). The records review completed by Ferriman (2011) indicated that an additional 13 previous investigations had included areas within or near the Study Area as defined at that time. The Tribes had been informed in staff-to-staff meetings with the BLM on January 10, 2011 and February 9, 2012 that baseline investigations would be conducted but did not participate in any of the studies.

All three of the current surveys for this Proposed Action revisited the reported location of the same prehistoric lithic scatter just outside their survey areas and concurred with the earlier recommendation that the site was not eligible for the National Register of Historic Places (NRHP). However, some inconsistencies remained in the reports, and State Historic Preservation Office (SHPO; 2011) recommended additional documentation of the site location. Two other previously recorded sites within or near the survey areas were not found.

The three surveys together (Ferriman 2011; Harding 2009; Mason 2009) documented 23 new cultural resources within the Study Area. SHPO requested additional documentation and evaluation of a previously recorded historic cabin. All of the sites in the Study Area were evaluated as not eligible for the NRHP, and SHPO concurred. The 21 previously and newly recorded cultural resources that are evaluated as not eligible include nine prehistoric isolated finds, four historic isolated finds, the remains of two historic bridges, two historic trash scatters, a cabin or ranch site with associated features, a historic ditch feature, an isolated piece of farm equipment, and a scatter of historic boards.

After the completion of the 2010 cultural resource inventory (Ferriman 2011), a larger Survey Area was defined to include project features and potential project alternatives that were outside the previously defined Study Area. These changes added 609 acres to the previously defined Study Area for a total area of 2,793 acres for the newly defined Survey Area. An updated records search was completed for the expanded analysis area, which included the Survey Area plus a 1-mile buffer in all directions (Idaho SHPO Records Search No. 12342). The SHPO record search and the CTNF records indicated that 24 previous cultural resource investigations have included portions of the cultural resources analysis area. Four of these investigations were not listed in the SHPO records (Polk 1990; Harding 2009; Ferriman 2011; Crockett 2011). Previous surveys, some of which overlapped, had covered all but 567 acres of the expanded Survey Area. Späth (2012) inventoried this final acreage. Consequently, the entire Survey Area as defined in 2012 has been surveyed for cultural resources or excluded from survey because of previous mine disturbance.

The Study Area was changed again in 2015 to accommodate the Proposed Action, adding another 106 acres for a total of 2,567 acres. This additional acreage was predominantly mined and reclaimed areas associated with the P4 South Rasmussen Mine and did not require additional survey. The cultural resource Survey Area had covered additional areas southwest of Angus Creek that were not included in the Study Area. This had been done in part to assess the feasibility of an alternative haul road that was not carried forward for analysis.

The updated records search included 37 cultural resource sites or isolated finds within the analysis area. These cultural resource sites are the 30 addressed by Ferriman (2011), two sites to the south that were outside Ferriman's search area, and five sites that were recorded by Crockett (2011) near Ferriman's survey area. These cultural resources include seven prehistoric lithic or artifact scatters, seven prehistoric isolated lithic artifacts, one site with both prehistoric and historic artifacts, four houses or cabins with associated materials, three historic structures, two clusters of farm equipment and associated materials, four historic artifact scatters, two clusters of carved aspen trees (arborglyphs), six isolated historic artifacts, and a ditch segment.

All but nine of the sites in the updated records search are within the Survey Area, and the majority are in Rasmussen Valley. The sites and isolated finds have been found predominantly in the valley bottoms along Angus Creek, Lanes Creek, the Blackfoot River, and minor tributaries. A smaller number have been found on ridges and lower slopes overlooking these drainages. No cultural resources have been identified on the crest or steep slopes of Rasmussen Ridge.

Ferriman (2011) provides a comprehensive summary of sites recorded within the analysis area through 2009. Späth (2012) addresses sites added by the expansion of the Survey Area in 2012, survey of previously unsurveyed portions, and re-evaluation of incompletely documented sites.

None of the cultural resources identified in the Survey Area have been recommended as eligible for the NRHP. The CTNF (Abusaidi 2013) and the BLM (Lapp 2013) submitted Determinations of Significance and Effect to SHPO agreeing with these recommendations, and SHPO has concurred. There are no identified historic properties within the Survey Area.

3.12 TRIBAL TREATY RIGHTS AND INTERESTS

The NHPA and its implementing regulations (36 Code of Federal Regulations [CFR] 800) require consultation with federally recognized Indian tribes to identify TCPs and consider potential effects on such properties because of a federal undertaking. In addition, the American Indian Religious Freedom Act of 1978 (AIRFA), EO 13175: Consultation and Coordination with Indian Tribal Governments, and EO No. 13007: “Indian Sacred Sites” contain requirements for consulting with tribes on the potential effects of federal actions on tribal interests. TCPs are cultural sites of religious or cultural importance that may also be eligible for the NRHP because of their importance in the traditions and cultural identity of a cultural group. Areas of traditional use may include areas used to gather plants, animals, or fish for subsistence or for ceremonial or medicinal purposes. National Register Bulletin No. 38 provides guidance for identification and evaluation of such TCPs and traditional use areas. The Native American Graves Protection and Repatriation Act (NAGPRA) requires that concerned tribes be consulted if human remains that may be Native American or objects of cultural patrimony are discovered.

The 1868 Fort Bridger Treaty, between the United States and the Shoshone and Bannock Tribes, reserves the Tribes right to hunt, fish, gather, and exercise other traditional uses and practices on unoccupied federal lands. In addition to these rights, the Shoshone Bannock have the right to graze tribal livestock and cut timber for tribal use on those lands of the original Fort Hall Reservation that were ceded to the federal government under the Agreement of February 5, 1898, ratified by the Act of June 6, 1900. The Study Area is not within the area ceded to the federal government under the Agreement of February 5, 1898.

Under this treaty and those agreements, the federal government has a unique trust relationship with the Shoshone-Bannock Tribes. BLM has a responsibility and obligation to protect Tribal treaty rights and to consider and consult on potential effects to natural resources related to the Tribes treaty rights or cultural use.

Even though the native groups have relinquished legal ownership of the lands outside the reservations, they continue to actively use the lands and resources to the extent possible, retain traditions and connections with the lands, and maintain connections with sacred sites. These sacred sites include burials, rock art, monumental rock features, natural features, rock structures or rings, sweat lodges, timber and brush structures, eagle traps, and prayer and offering localities. Much of the landscape itself figures prominently in the identity and traditions of the native groups, and sacred places are not necessarily defined by archaeological remains.

The federal government has a unique trust relationship with federally recognized American Indian tribes including the Shoshone and Bannock Tribes. The BLM and the CTNF have a responsibility and obligation to consider and consult on potential effects to natural resources related to the Tribes' treaty rights, uses, and interests under the federal laws, EOs, and treaties noted above. Resources or issues of interest to the Tribes that could have a bearing on their traditional use or treaty rights include tribal historic and archaeological sites, sacred sites and TCPs, traditional use sites, fisheries, traditional animal species, culturally significant plants, vegetation (including noxious and invasive, non-native species), air and water quality, wildlife, access to lands and continued availability of traditional resources, land status, and the visual quality of the environment (additional information is provided for these resources in other resource sections of this chapter). The BLM and the CTNF recognize the Shoshone-Bannock Tribes Policy for Management of Snake River Basin Resources including the Tribes' determination to pursue and promote efforts to restore the Snake River systems and affected unoccupied lands to a natural condition, and their desire to ensure the protection, preservation, and enhancement of tribal treaty rights and interests. The BLM and the CTNF are engaged in ongoing staff-to-staff consultation with the Tribes. To date, the Tribes have not identified any sacred sites in the Study Area.

3.13 SOCIAL AND ECONOMIC CONDITIONS

The Proposed Action is located in northeast Caribou County, Idaho, near the northern end of the Southeast Idaho Phosphate District. Caribou County is the economic center of this phosphate district, which is historically one of the largest and most productive areas of mineral production in the State of Idaho. The county is heavily affected by phosphate mining.

The communities located nearest to the Proposed Action are the City of Soda Springs (the Caribou County seat) and the Town of Grace, which is located 8 miles southeast of Soda Springs. Mining and related industries comprise the economic base of the county, and are a major source of employment for residents of both communities. The two communities are the largest in Caribou County, and together account for nearly 60 percent of the population in the county. Cities with the easiest access to Soda Springs and the Proposed Action are located along U.S. Highway 30. These include Montpelier and Pocatello. The City of Montpelier in Bear Lake County is nearly 30 miles southeast of Soda Springs on U.S. Highway 30. Pocatello is located nearly 60 miles northwest in Bannock County. Several small communities along the highway and connecting roads are within a 1- to 1.5-hour commuting distance of the Proposed Action, including several small communities in the Star Valley in Lincoln County, Wyoming.

This section describes the existing socioeconomic structure of Caribou County, Idaho and the communities of Soda Springs and Grace, Idaho, including population, economy, housing, and community services. Other counties in southeast Idaho and western Wyoming would provide a portion of the workforce at the Rasmussen Valley Mine. Therefore, in addition to Caribou County, the analysis area includes Bear Lake County and Bannock County, Idaho, and Lincoln County, Wyoming. The analysis focuses primarily on Caribou County because that is where the Proposed Action is located. The majority of effects to existing social and economic conditions, including effects to community services and fiscal impacts, would occur in the county because most of the mine's employees likely would reside there (Qu and Anderson 2014).

3.13.1 Phosphate Mining/Manufacturing Industry

Phosphate mining and the associated manufacturing industry are a backbone of the economy of southeastern Idaho, and drive the economy of Caribou County. In Caribou County, where many of the mines and two of the manufacturing facilities are located, mining and manufacturing account for more than half of the wages earned in the county, while accounting for only one third of jobs. Each direct mining or manufacturing position is estimated to create two additional jobs in the economy (Peterson 2013).

The project Proponent's mining and manufacturing activities in southeastern Idaho alone employ approximately 480 people, paying approximately $30 million in wages and benefits. This accounts for nearly 20 percent of all wages paid in Caribou County. Factoring in the indirect and induced jobs created throughout the local economy, the Proponent's activities account for 912 jobs in Caribou County and nearly $65 million in compensation (approximately 30 percent of all jobs and 27 percent of the total compensation in the county). Looking beyond Caribou County, the Proponent's operations generate 777 jobs elsewhere in Idaho, creating almost $58 million in total compensation. The Proponent's operations generate approximately $212 million in gross regional product, spend more than $85 million in the local economy, and pay approximately $5 million per year in state taxes and more than $3.8 million annually in royalty payments (Peterson 2013).

3.13.2 Population

The current and historical populations of the four counties and their communities are shown in **Table 3.13-1**. The rural/urban distribution of the population is shown in **Table 3.13-2**, and the age distribution of the population is shown in **Table 3.13-3**.

Historically, population gains and losses in the analysis area have been tied to resource development, including mining. As mines have opened and closed in response to resource exhaustion or economics, Caribou County and Bear Lake County have lost and gained population. The larger, more diversified economy of Bannock County accounts for the positive growth over time, even during periods when other counties were losing population. As presented in **Table 3.13-2**, the populations of Idaho as a whole and Bannock County have become more urbanized over time. Conversely, the percentage of the population of Caribou County and Bear Lake County living in rural areas has increased over the same period. As seen in **Table 3.13-3**, the median age in Caribou County and Lincoln County is roughly equivalent, the population of Bear Lake County skews slightly older, and the population of Bannock County skews younger.

3.13.3 Economy and Employment

The economies of Bear Lake County, Caribou County, and Lincoln County are characterized by a dependence on natural resources, including mining, phosphate processing, and agriculture. **Table 3.13-4** presents the numbers of workers employed in each industrial sector and the annual average wage paid in each sector.

The importance of natural resources-related jobs to the economies of Bear Lake, Caribou, and Lincoln Counties can be seen in the high average annual wages associated with mining and manufacturing in Caribou County. While relatively few in number, these high-wage jobs generate economic impacts throughout the economy.

Tourism is an increasingly important economic sector, particularly in Bear Lake County. However, many positions in this sector are seasonal, which is reflected in the low average annual wage for that type of employment. Government employment accounts for more than 20 percent of the jobs in all four counties, with a particularly large number of jobs in Bannock County associated with the Idaho State University. The local, state, and federal government agencies in all four counties offer stable employment.

The following sections provide an overview of income and employment in the four counties, as well as information on local government revenue sources.

3.13.3.1 Unemployment and Labor Force

Labor force, employment, and unemployment data are presented in **Table 3.13-5**. Employment in the four counties is seasonal, with employment peaks in the summer months corresponding with construction work and the tourist season, as well as increased work in the oil and gas fields in the area.

3.13.3.2 Income

Per capita income in the four counties is presented in **Table 3.13-6**. Information for the States of Idaho and Wyoming is also provided for comparative purposes. Of the four counties, only Caribou County displays a net outflow of personal income, which indicates that individuals work in Caribou County but live elsewhere (the outflow of personal income represents money earned in Caribou County flowing to other counties where individuals reside). Approximately 21 percent of the income earned within Caribou County is earned by those living elsewhere (i.e., those who commute to jobs in Caribou County while residing outside the county).

3.13.3.3 Bannock County Profile

Bannock County has a larger, more diverse economy than the other counties. In the analysis area, the economy is driven by trade and the presence of Idaho State University. The trade and service industries provide nearly half the jobs in Bannock County, while government provides almost a quarter of the jobs (**Table 3.13-4**). Although mining operations in the county have decreased over the past decade, leading to a loss in relatively high-paying jobs in the county, food manufacturing and construction activity have increased because of the construction of manufacturing facilities that have relocated to the county.

As presented in **Table 3.13-5**, over the past two decades, Bannock County's unemployment rates have approximated or been lower than that for the State of Idaho. The unemployment rate fell to 2.7 percent in 2007, rising to 7.9 percent in 2010, and has decreased since to 6.3 percent in 2013 (IDoL 2013). **Table 3.13-6** shows an inflow of personal income for Bannock County, indicating that workers commute to jobs outside the county.

Approximately 53 percent of Bannock County's revenues are sourced from property taxes, with approximately 23 percent coming for charges for services. The county has a policy of reducing, where possible, property taxes and replacing that income stream with additional charges for services. Operating grants and other taxes each account for approximately 10 percent of revenue (Bannock County 2012). Bannock County received $486,380 in Payment In Lieu of Taxes (PILT) payments from the federal government in fiscal year (FY) 2014 (USDI 2014).

Table 3.13-1 Population and Population Growth in the Analysis Area Counties and the States of Idaho and Wyoming, 1970 to 2010

	1970	1980	% Change, 1970-1980	1990	% Change, 1980-1990	2000	% Change, 1990-2000	2010	% Change, 2000-2010
State of Idaho	713,015	944,038	32.4	1,006,734	6.6	1,293,953	28.5	1,567,582	21.1
Caribou County	6,534	8,695	33.1	6,963	-19.9	7,304	4.9	6,963	-4.7
Soda Springs	3,540	4,051	14.4	3,111	-23.2	3,381	8.7	3,058	-9.6
Grace	826	1,216	47.2	973	-20.0	990	1.7	915	-7.6
Bear Lake County	5,801	6,931	19.5	6,084	-12.2	6,411	5.4	5,986	-6.6
Montpelier	2,604	3,107	19.3	2,656	-14.5	2,785	4.9	2,597	-6.8
Bannock County	52,200	65,421	25.3	66,026	0.9	75,565	14.4	82,839	9.6
Pocatello	40,636	46,724	15.0	46,080	-1.4	51,605	12.0	54,255	5.1
State of Wyoming	332,416	469,557	41.3	453,588	-3.4	493,782	8.9	563,626	14.1
Lincoln County	8,640	12,177	40.9	12,625	3.7	14,573	15.4	18,106	24.2

Sources: U.S. Census Bureau (USCB) 1981, 2001, 2012b

Table 3.13-2 Rural and Urban Distribution of Population by Percentage of Populace, 1970 to 2010

	1970		1980		1990		2000		2010	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
State of Idaho	45.9	54.1	46	54	42.6	57.4	33.6	66.4	29.4	70.6
Caribou County	54.4	45.6	53.4	46.6	55.3	44.7	58.4	41.6	59.9	40.1
Bear Lake County	55.1	44.9	55.2	44.8	56.3	43.7	57.5	42.5	100	0
Bannock County	17.7	82.3	18.4	81.6	16.4	83.6	17.3	82.7	15.7	84.3
State of Wyoming	39.5	60.5	44.1	55.9	35.0	65.0	34.9	65.1	35.2	64.8
Lincoln County	100	0	68.2	31.8	76.1	23.9	79.9	20.1	82.7	17.3

Sources: USCB 1981, 2001, 2012b

Table 3.13-3 Age Distribution in Analysis Area Counties (2010)

Age	Caribou County, ID		Bear Lake County, ID		Bannock County, ID		Lincoln County, WY	
	Number	% of Total	Number	% of Total	Number	% of Total	Number	% of Total
0-4	597	7.4	410	6.8	6,971	8.4	1,449	8.0
5-19	1,605	23.1	1,357	22.7	18,561	22.4	4,014	22.2
20-44	1,877	27.0	1,483	24.8	29,081	35.1	5,287	29.2
45-64	1,831	26.3	1,632	27.3	18,983	22.9	5,115	28.3
65+	1,103	15.8	1,104	18.4	9,243	11.2	2,241	12.4
Median age	37.7		40.5		31.4		37.4	

Source: USCB 2012a

Table 3.13-4 Employment and Wages by Economic Sector in Caribou, Bear Lake, Bannock, and Lincoln Counties (2012)

Economic Sector	Caribou County, ID		Bear Lake County, ID		Bannock County, ID		Lincoln County, WY	
	Average Employment	Average Wages	Average Employment	Average Wages	Average Employment	Average Wages	Average Employment	Average Wages
Total Employment (Covered)	3,094	$45,136	1,677	$24,330	30,543	$32,535	5,685	$42,395
Agriculture	112	$24,247	*	*	91	$26,497	18	$24,028
Mining	361	$62,381	4	$100,135	*	*	623	$93,928
Construction	339	$48,701	41	$30,191	1,540	$41,955	637	$42,660
Manufacturing	665	$81,944	42	$26,557	2,157	$50,397	133	$33,871
Trade, Utilities, & Transportation	389	$30,827	432	$21,497	5,746	$28,411	1,078	$39,827
Information	19	$18,526	20	$9,446	365	$32,326	159	$43,190
Financial Activities	95	$32,048	46	$26,508	1,517	$41,097	122	$38,484
Professional and Business Services	112	$32,465	98	$34,270	3,007	$30,764	295	$36,061
Educational and Health Services	102	$16,338	97	$16,344	5,094	$33,557	1,469	$37,554
Leisure and Hospitality	180	$9,805	216	$11,366	3,346	$11,791	481	$10,771
Other Services	53	$22,360	27	$16,642	738	$24,793	146	$20,196
Government	667	$29,618	653	$29,833	6,933	$37,349	1,758	$40,903

Note:

* indicates where data have been withheld

Source: Idaho Department of Labor (IDoL) 2013; Bureau of Labor Statistics (BLS) 2013

Table 3.13-5 Labor Force Characteristics in Caribou, Bear Lake, Bannock, and Lincoln Counties

	US	Idaho	Caribou (ID)	Bear Lake (ID)	Bannock (ID)	Lincoln (WY)
1990						
Total Labor Force	118793000	492490	2965	2379	31319	5778
Employed	111746000	465255	2824	2255	29194	5413
Unemployed	7047000	27235	141	124	2125	365
Unemployment Rate	5.6	5.5	4.8	5.2	6.8	6.3
2000						
Total Labor Force	136891000	659824	3273	2960	38370	7357
Employed	131199000	628844	3109	2817	36618	7072
Unemployed	5692000	30980	164	143	1752	285
Unemployment Rate	4.0	4.7	5.0	4.8	4.6	3.9
2010						
Total Labor Force	139064000	761056	3769	3259	40136	8366
Employed	124239000	692826	3485	3057	36981	7576
Unemployed	14825000	68230	284	202	3155	7890
Unemployment Rate	9.6	9.0	7.5	6.2	7.9	9.4
2013						
Total Labor Force	143929000	771154	3956	3321	39990	7810
Employed	132469000	724121	3745	3173	37490	7348
Unemployed	1460000	47033	211	148	2500	462
Unemployment Rate	7.4	6.1	5.3	4.5	6.3	5.9

Source: BLS 2013

Table 3.13-6 Income and Outflow in Idaho, Wyoming, and in the Analysis Area (2012)

	Per Capita Income	Personal Income	Income Inflow/Outflow
State of Idaho	$35,142	$56,071,934,000	
Bannock County	$30,251	$2,531,478,000	$75,772,000 inflow
Bear Lake County	$33,754	$199,286,000	$35,831,000 inflow
Caribou County	$40,190	$272,408,000	$55,557,000 outflow
State of Wyoming	$52,469	$30,255,128,000	
Lincoln County	$41,293	$741,615,000	$46,888,000 inflow

Source: Bureau of Economic Analysis (BEA) 2014a, 2014b

Table 3.13-7 Major Employers in the Analysis Area.

Bannock County	Bear Lake County	Caribou County	Lincoln County
Beacon Health Services	Alco Discount Store	Agrium	Westmoreland Coal Company
Belmont Care Center	Bear Lake County	Broulims Foodtown	PacifiCorp
Convergys Customer Management	Bear Lake County School District #33	Degerstrom-Dravo	ExxonMobil
Farmers Insurance	Bear Lake Memorial Hospital	J.R. Simplot Co., Smoky Mine	Williams
Amy's Kitchen	Broulims Foodtown	Kiewit	Enterprise
Idaho State University	IVI Hotel Management	Mark III	BTI
Portneuf Medical Center	U.S. Forest Service	Monsanto Company	Lincoln County
ON Semiconductor, Inc.	Walton Feed, Inc.	Mullen Crane & Transport	Lincoln County School Districts #1 and #2

Note:
Alco Discount Store has, as of 2015, ceased to operate.
Source: IDoL 2013; Zions Bank Public Finance 2012

3.13.3.4 Bear Lake County Profile

The economy of Bear Lake County is dominated by government employment and tourism-related employment; each accounted for approximately 40 percent of the jobs in 2012. Tourism-related employment increased through the 1990s as Bear Lake County became an increasingly popular locale for recreational and second homes. Bear Lake County is a source of labor for projects in neighboring counties. As a result, employment rates in the county are subject to changes in neighboring counties to a greater degree than for Caribou or Bannock Counties. For example, when oil and gas exploration and development projects in neighboring Utah and Wyoming counties decreased in the 1990s, and when mining positions in Caribou County decreased in the early 2000s, the unemployment rate in Bear Lake County rose (IDoL 2013).

During the last 10 years, Bear Lake County's unemployment rates have been consistently lower than those for the State of Idaho and the U.S., with the unemployment rate falling as low as 2.2 percent in 2007. The rate stood at 6.2 percent in 2010, and fell to 4.5 percent in 2013. Because of Bear Lake County's tourism-based economy, wages in Bear Lake County are lower than in most of the state. **Table 3.13-6** shows an inflow of personal income for Bear Lake County, indicating that workers commute to jobs outside the county. Bear Lake County received $556,564 in PILT payments from the federal government in FY2014 (USDI 2014).

3.13.3.5 Caribou County Profile

The economy of Caribou County is based on agriculture, phosphate mining, and manufacturing. Consequently, the county's economy (and population) is subject to national and global economic forces. As commodity prices trend up and down, so do the economy and population. As a result, unemployment rates in the county tend to vary more substantially than those for the state or the U.S. (IDoL 2013).

Nearly half the jobs in Caribou County involve the production of fertilizer and phosphorus. In 2012, manufacturing accounted for 21 percent of employment and paid the best wages. Mining and construction accounted for 23 percent of employment, and government provided 22 percent of non-farm jobs (**Table 3.13-4**). Wages in Caribou County are higher than for most of the state because of the high wages paid in the phosphate mining and manufacturing industries. Caribou County received $359,964 in PILT payments from the federal government in FY2014 (USDI 2014).

3.13.3.6 Lincoln County Profile

The primary drivers of Lincoln County's economy include mining, construction, government, education, transportation, trade, and utilities, which is reflected in the largest employers listed in **Table 3.13-7**. As shown in **Table 3.13-4**, the mining and construction sector accounts for approximately 11 percent of jobs and very high annual average earnings per job. Other generators of large numbers of jobs include the trade, utilities, and transportation, educational and health services, and government sectors. Lincoln County has historically been a net exporter of labor to surrounding counties, as represented in **Table 3.13-6**, which shows an inflow of personal income for Lincoln County.

Taxes comprise the largest source of revenue for the county. Property and motor vehicle taxes account for 47 percent of total revenues. Sales and use taxes account for 22 percent of total revenues. Operating grants and capital grants represent 12 and 8 percent of total revenues, respectively. Intergovernmental transfers account for approximately 3.5 percent of total revenue, and charges for services represent approximately 5 percent of total revenue. Property, sales, and use tax revenues have increased recently because of increased oil and gas activity in the southern portion of the county (Lincoln County 2012). Lincoln County received $1,214,569 in PILT payments from the federal government in FY2014.

3.13.4 Housing

The characteristics of housing in the analysis area are presented in **Table 3.13-8**. The housing stock in all four counties is relatively concentrated. Approximately 63 percent of the total housing units in Caribou County are located in the Soda Springs Census Designated Place (Soda Springs CDP), approximately 68 percent of housing units in Lincoln County are located in the Afton Census County Division (Afton CCD), and approximately 86 percent of the housing units in Bannock County are located in the Pocatello CCD.

Table 3.13-8 Housing Characteristics in the Analysis Area (2010)

Housing Unit Type	Bannock County, ID	Bear Lake County, ID	Caribou County, ID	Lincoln County, WY
Total Housing Units	33,191	3,914	3,226	8,946
Occupied	30,682	2,281	2,606	6,861
Vacant	2,509	1,633	620	2,085
Vacant for Rent	864	81	94	319
Vacant for Sale	501	92	42	238
Vacant for Seasonal Use	444	1,226	288	1,186
Rental Vacancy Rate (percentage)	8.0	15.8	14.8	17.8
Owner Occupied	20,817	2,281	2,067	5,410
Renter Occupied	9,865	426	539	1,451

Source: USCB 2012c

Increasing demand in Bannock County has resulted in rising costs for land and housing, and increased concern about the affordability of housing. Such issues have not been documented for the other three counties in the analysis area. The housing stock in Bear Lake County differs from the other counties in the large percentage of seasonal-use houses. The housing stock in Bear Lake County is relatively old, with more than 37 percent of houses built before 1940 (Bear Lake County 2002). In a similar vein, the existing housing stock in Soda Springs has been characterized as degraded (IRP 2007).

3.13.5 Community Services

3.13.5.1 Schools

There are two school districts in Bannock County (Marsh Valley School District and Pocatello/ Chubbuck School District No. 25), three school districts in Caribou County (Grace School District, North Gem School District, and Soda Springs School District), and one district in Bear Lake County (Bear Lake School District). There are two school districts in Lincoln County (Lincoln County School Districts #1 and #2). The attendance in these districts for selected years is presented in **Table 3.13-9**.

Communities nearest the analysis area are served by three school districts: the Soda Springs School District #150, the Grace School District #148, and North Gem School District #149. There are three schools in Soda Springs School District #150 (Thirkill Elementary School, Tigert Middle School, and Soda Springs High School), three schools in Grace School District #148 (Thatcher Elementary School, Grace Elementary School, and Grace Junior/Senior High School), and three schools in North Gem School District #149 (North Gem Elementary School, North Gem Middle School, and North Gem High School).

Table 3.13-9 School Enrollment in the Analysis Area

	1991-1992	2001-2002	2011-2012	2012-2013
Caribou County, ID				
Soda Springs School District	1,324	1,060	803	800
Grace School District	719	547	426	464
North Gem School District	230	194	196	217
Bannock County, ID				
Marsh Valley School District	1,590	1,471	1,260	1,258
Pocatello/Chubbuck School District No. 25	13,839	12,370	12,900	12,816
Bear Lake County, ID				
Bear Lake School District	1,734	1,501	1,088	1,101
Lincoln County, WY				
Lincoln County School District #1	--	724	612	603
Lincoln County School District #2	--	2,386	2,601	2,559

Note:
ND = No Data
Source: Idaho Department of Education 2013, Wyoming Department of Education 2013

Adult education in the region is provided through the College of Southern Idaho, a community college in Twin Falls, and Idaho State University in Pocatello.

3.13.5.2 Law Enforcement

The Caribou County Sheriff's Department provides law enforcement for Caribou County; enforcement in Soda Springs is provided by the Soda Springs Police Department (IDC 2006). The Bannock County Sheriff's Office provides law enforcement throughout the county from its Office in Pocatello. Law enforcement within Pocatello is provided by the Pocatello Police Department. The Bear Lake County Sheriff's Office, located in Paris, provides law enforcement for the county. Detention facilities are located in Pocatello, Soda Springs, and Montpelier. The Idaho State Patrol also provides law enforcement services in the region, with officers stationed in all three counties.

The Lincoln County Sheriff's Office provides public safety and law enforcement to all unincorporated areas of Lincoln County. The office maintains facilities (including jail facilities) in Kemmerer, and has a branch office in Afton. The Kemmerer Police Department and Afton City Police Department provide law enforcement within their respective cities.

3.13.5.3 Fire and Emergency Medical Services

Caribou County has a volunteer fire department that serves the unincorporated areas of the county. Fire protection services in Soda Springs are provided by the Soda Springs Fire Department, which is manned by volunteer personnel (IDC 2006), and fire protection in Grace is provided by a volunteer fire department (GCC 2008). Caribou County Emergency Medical Services provides EMT services to the county.

Unincorporated Bannock County is served by the Pocatello Valley, Inkom, McCammon, Lava, Arimo, and Downey Fire Districts. These are volunteer districts. The Pocatello Fire Department provides service within the city. There are eight licensed emergency medical services providers in Bannock County, including both private and public entities.

Bear Lake County is covered by two fire districts: Bailey Creek and Bear Lake. The Bailey Creek Fire District contracts its fire protection service from Caribou County. The Bear Lake County Fire District is an all-volunteer district. It operates stations in Paris, Dingle, Ovid, Georgetown, Pegram, Geneva, Fish Haven, St. Charles, Bennington, and Nounan (Bear Lake County 2002). The Bear Lake County Ambulance Service provides EMT services in the county.

The Bear River Fire District's all-volunteer force provides fire protection services in southwest Lincoln County. Its single station is located in Cokeville. The Alpine Fire Department is a volunteer force providing fire protection and emergency medical services in that community. Kemmerer and Afton each have a volunteer fire department. South Lincoln Emergency Medical Services provides EMT services in southern Lincoln County, and Star Valley Medical Center Emergency Medical Services provides EMT services to Afton and surrounding areas.

3.13.5.4 Medical Services

The Caribou County Hospital and Nursing Home in Soda Springs provides comprehensive health care facilities, including a full-service hospital with 25 beds, emergency care, and industrial testing. The hospital also provides a 30-bed skilled nursing home. There are also a variety of health practitioners and specialists in the area (CMH 2013).

In Bannock County, the Portneuf Medical Center is located in Pocatello. The county's population is also served by a number of other medical providers, including community health centers, hospices, and skilled nursing facilities.

Bear Lake Memorial Hospital in Montpelier includes a skilled nursing facility and an assisted living center. In addition, the population of the county is served by three rural health clinics.

In Lincoln County, the South Lincoln Hospital District operates the South Lincoln Medical Center, which is a designated Critical Access Hospital. The facility includes an emergency room, intensive care unit, medical clinic, and a nursing home among other services. In Afton, the Star Valley Medical Center includes an emergency room, hospital facility, and a long-term care facility among others.

3.13.5.5 Utilities and Public Services

The Rocky Mountain Power Company provides residential electricity in Bannock County, Bear Lake County, Lincoln County, and much of Caribou County. Electric service in Soda Springs is provided by Soda Springs Municipal Light and Power.

Communities in the four counties generally have a centralized water transmission and distribution system and wastewater system. Outside the communities, water is generally sourced from wells or springs, and septic systems are used (Bear Lake County 2002).

Caribou County operates a landfill located near Grace. Bannock County operates the Fort Hall Canyon Landfill (Bannock County 2010; Caribou County 2013). Bear Lake County operates a solid waste landfill located 2 miles east of Montpelier. The county owns and operates the solid waste pickup service that provides service throughout the incorporated and unincorporated parts of the county (Bear Lake County 2002). Lincoln County operates landfills near Kemmerer, Cokeville, and Thayne (Lincoln County 2013).

3.13.6 Public Finance

Public finance activities, lease fees, taxes, and other fees paid to the federal, state, and local entities impact Caribou County, the State of Idaho, and the federal government. Because facilities associated with the Proposed Action are not proposed in Bear Lake, Bannock, or Lincoln Counties, fees associated with mining would not apply. Therefore, the following discussion is restricted to Caribou County.

The taxes and royalties assessed on mineral development and production are an important source of revenue for the State of Idaho and local governments including Caribou County. Property taxes on Agrium-owned property generate approximately $1.1 million annually. An additional $650,000 in property taxes is generated from other properties (e.g., contractor properties, employee properties) associated with the mining activities; in total, these property taxes account for 28 percent of Caribou County's total property tax receipts (Peterson 2013).

In addition to property taxes, the project proponent paid approximately $3.8 million in royalties, $19.5 million in federal corporate tax, and $4.9 million in state corporate tax in 2012 (Peterson 2013).

There are currently three mines actively extracting phosphate in Idaho, all located in Caribou County east and northeast of Soda Springs. Ninety-seven percent of federal receipts from mining fees, leases, and permits that originate in Caribou County are from phosphate mining production. In FY 2013, the total reported royalty revenue, including rents and bonuses, from phosphate operations in Idaho was $9,927,290.

The Federal Mineral Leasing Act of 1920 directs that half of all federally collected rents and royalties be distributed to the individual states where production occurred. Ten percent of this amount is earmarked to be given to the county where production occurred.

A mine license tax of 1 percent is collected by the state for the value of ores mined or extracted. In FY 2013, the state collected revenues of $959,166 from the mine license tax, a decrease of $2,261,279 from the 2012 revenues of $3,220,445 (ISTC 2013).

Property taxes are levied by Caribou County on facilities and improvements constructed by companies. The average 2013 tax rate for rural areas in Caribou County was 1.054 percent (ISTC 2013).

3.14 ENVIRONMENTAL JUSTICE

U.S. EO 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations directs federal agencies to assess whether the Proposed Action or alternatives would have disproportionately high and adverse human health or environmental impacts on minority or low-income populations.

Data in this section are presented for several different geographies. The Wayan CCD is the smallest geographic area that has a population and for which racial, ethnic, and poverty status data are available. Census Tract 9602 encompasses the Wayan CCD and that portion of Caribou County in which the Proposed Action is located. Caribou County and the State of Idaho represent larger geographic areas that are useful for comparison purposes. None of the Census Blocks nearest the mine site are populated, and thus data for these Census Blocks are not presented.

3.14.1 Minority Populations

The Rasmussen Valley Mine site is located in a sparsely populated rural area of eastern Caribou County. The site is located in Census Tract 9602 in the Wayan CCD. Most of the Proposed Action is located in Census Block 1416. Census 2010 data indicate that Census Block 1416 and the adjoining Census Blocks are unpopulated. Demographic information for the Wayan CCD and Census Tract 9602 is provided in **Table 3.14-1**. Information for the State of Idaho and the Fort Hall Reservation and Off-Reservation Trust Land is provided for comparative purposes.

Because the Census Blocks nearest the Proposed Action are unpopulated, and given the information presented in **Table 3.14-1**, those identifying as minorities or as Hispanic or Latino do not comprise a majority in or near the Proposed Action. The Wayan CCD has a higher percentage of those identifying as a minority, Hispanic, or Latino than the larger Census Tract (9602) in which the CCD is located. The demographic composition of the Wayan CCD approximates that of the State of Idaho as a whole.

Table 3.14-1 Racial and Ethnic Composition

Race or Ethnic Group	Wayan CCD		Census Tract 9602		State of Idaho		Fort Hall Reservation and Off-Reservation Trust Land, ID	
	Number	%	Number	%	Number	%	Number	%
Total Population	232	100.0	2,872	100.0	1,567,652	100.0	5,337	100.0
White	214	92.2	2,755	95.9	1,396,487	89.1	1,838	34.4
Black or African American	0	0.0	2	0.1	9,810	0.6	0	0.0
American Indian or Alaskan Native	0	0.0	5	0.2	21,441	1.4	3,352	62.8
Asian	0	0.0	4	0.1	19,069	1.2	6	0.1
Native Hawaiian or Other Pacific Islander	0	0.0	12	0.4	2,317	0.1	0	0.0
Other Single Race	21	9.1	52	1.8	79,523	5.1	20	0.4
Two or More Races	3	1.3	42	1.5	38,935	2.5	121	2.3
Hispanic or Latino*	23	9.9	108	3.8	175,901	11.2	617	11.6

Notes:

* People who identify their origin as Hispanic or Latino may be of any race.

Source: USCB 2012a

The Fort Hall Indian Reservation is located 30 miles west of the Proposed Action. As shown in **Table 3.14-1**, those identifying as minorities comprise a majority on the Fort Hall Reservation and Off-Reservation Trust Lands. The Shoshone-Bannock Tribes represent both a population (readily identifiable collection of persons) and a community (readily identifiable social group who reside in a specific locality, share government, and have a common cultural and historical heritage). The Proposed Action is not directly associated with or located in proximity to the Fort Hall Indian Reservation; however, because of treaty rights and tribal interests in public lands in the region, the Fort Hall Indian Reservation is addressed in **Section 3.12**.

3.14.2 Low-Income Populations

Data on low-income populations near the Proposed Action are presented in **Table 3.14-2**. These data indicate that the numbers of people living in Caribou County and in Census Tract 9602 whose income is below the poverty level is lower than that of the State of Idaho as a whole, and that there are no individuals living in the Wayan CCD whose income is below the poverty level.

Table 3.14-2 Low-Income Population Data

	Total Population		Low Income Population		Percentage	
	2010 Estimate[1]	2007-2011 5-Year Estimate[2]	2010 Estimate[1]	2007-2011 5-Year Estimate[2]	2010 Estimate[1]	2007-2011 5-Year Estimate[2]
State of Idaho[1]	1,544,361	1,519,070	244,009	216,734	15.8	14.3
Caribou County[1]	6,884	6,780	833	635	12.1	9.4
Soda Springs School District[1]	879 (students)	NA	101 (students)	NA	11.5	NA
Census Tract 9602[2]	NA	2,755	NA	242	NA	8.8
Wayan CCD[2]	NA	141	NA	0	NA	0.0
Fort Hall CDP[2]	NA	2,727	NA	673	NA	24.7

Notes:
CCD – Census County Division
CDP – Census Designated Place
NA – not analyzed
Population data may differ from other USCB data as a result of differing data collection and analysis
Sources:
1 USCB 2013a
2 USCB 2013b

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